EXHIBIT I

TO THE DECLARATION OF ARPITA BHATTACHARYYA IN SUPPORT OF ASETEK DANMARK A/S'S MOTION FOR PARTIAL SUMMARY JUDGMENT

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ASETEK DANMARK A/S,
Petitioner,

v.

COOLIT SYSTEMS, INC.,
Patent Owner

Case IPR2020-00825
U.S. Patent No. 10,274,266
Issue Date: April 30, 2019

Title: FLUID HEAT EXCHANGE SYSTEMS

CORRECTED PATENT OWNER'S RESPONSE

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LIST OF EXHIBITS

Exhibit No.	Description of Document
2001	Declaration of Marc Hodes, Ph.D.
2002	H.Y. Zhang et al., *Single-phase liquid cooled microchannel heat sink for electronic packages*, Applied Thermal Engineering 25
2003	*Viton™ Fluoroelastomers: High-Performance*, available from www.viton.com/en/products (last visited July 12, 2020).
2004	Engineering CAD drawing, *Universal FHE*, dated July 31, 2007
2005	CooIT's First Amended Answer to Complaint for Patent Infringement and First Amended Counterclaims in Case No. 19-cv-00410-EMC
2006	Report on the Filing or Determination of an Action Regarding U.S. Patent No. 8,746,330
2007	Complaint for Patent Infringement in Civil Case No. 12-cv-04498-EMC (California Northern District)
2008	Civil Docket for Case No. 19-cv-00410-EMC (last visited July 14, 2020)
2009	Docket Navigator's Report on Motion Pendency before Judge Chen
2010	Docket Navigator's Report on Milestones in Patent Cases before Judge Chen
2011	Asetek's and CoolIT's Joint Claim Construction and Pre-Hearing Statement in Case No. 19-cv-00410-EMC
2012	Asetek's Opening Claim Construction Brief in Case No. 19-cv-00410-EMC

Exhibit No.	Description of Document
2013	CoolIT's Opening Claim Construction Brief in Case No. 19-cv-00410-EMC
2014	Asetek's Responsive Claim Construction Brief in Case No. 19-cv-00410-EMC
2015	CoolIT's Responsive Claim Construction Brief in Case No. 19-cv-00410-EMC
2016	Asetek's Reply Claim Construction Brief in Case No. 19-cv-00410-EMC
2017	CoolIT's Reply Claim Construction Brief in Case No. 19-cv-00410-EMC
2018	Asetek's Invalidity Contentions in Case No. 19-cv-00410-EMC
2019	Exhibit D-1 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [*Bezama*]
2020	Exhibit D-4 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [*Lyon-Bezama*]
2021	Exhibit D-7 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [*Bezama-Chiang*]
2022	Exhibit D-10 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [*Bezama-Lyon-Chiang*]
2023	Exhibit D-15 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [*Kang*]
2024	Exhibit D-16 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [*Anderson*]
2025	Petition for *Inter Partes* Review (IPR2015-01276)
2026	Institution Decision (IPR2015-01276)

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2027	Final Written Decision (IPR2015-01276) (Confirming patentability of all challenged claims)
2028	U.S. Pub. No. 2007/0163750 (*Bhatti*)
2029	Markman Order in Case No. 19-cv-00410-EMC
2030	Civil Docket for Case No. 19-cv-00410-EMC (as of August 5, 2020)
2031	Amended Case Management and Pretrial Order for Claim Construction in Case No. 19-cv-00410-EMC
2032	Typical costs of litigation; AIPLA 2019 Report of the Economic Survey
2033	Ex. D-2 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [Koolance-Bezama]
2034	Ex. D-8 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [Koolance-Bezama-Chiang].
2035	Ex. D-13 to Asetek's Invalidity Contentions Pertaining to the '266 Patent [Antarctica-Satou]
2036	Affidavit of Reuben Chen In Support of Motion for *Pro Hac Vice* Admission
2037	Biography of Reuben Chen In Support of Motion for *Pro Hac Vice* Admission
2038	Declaration of Himanshu Pokharna
2039	Declaration of Dr. Himanshu Pokharna in Connection With Claim Construction, Civil Docket No. 105-3, Case No. 3-19-cv-00410-EMC (N.D. Cal.)
2040	Deposition Transcript of Donald Tilton, dated December 19, 2020 – IPR2020-00747

Exhibit No.	Description of Document
2041	*Merriam Webster's Collegiate Dictionary* (11th ed. 2011), 413, 765 (definitions of "mate" and "engage")
2042	*Brazing Handbook* (4th ed. 1991), American Welding Society, copyright 2002
2043	Shigley, et al. (eds.), *Standard Handbook of Machine Design*, Gaskets, 2 ed. (1996) (excerpts)
2044	File History for Patent No. 8,746,330
2045	Deposition of Donald Tilton, dated December 19, 2020, Depo. Exhibit 2038 – IPR2020-00747
2046	Deposition of Donald Tilton, dated December 19, 2020, Depo. Exhibit 2039 – IPR2020-00747
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2049	Deposition of Donald Tilton, dated December 19, 2020, Depo. Exhibit 2042 – IPR2020-00747
2050	Deposition Transcript of Donald Tilton dated December 17, 2020
2051	Deposition of Donald Tilton, dated December 17, 2020, Depo. Exhibit 2038
2052	Deposition of Donald Tilton, dated December 17, 2020, Depo. Exhibit 2039
2053	Deposition of Donald Tilton, dated December 17, 2020, Depo. Exhibit 2040

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2054	Deposition of Donald Tilton, dated December 17, 2020, Depo. Exhibit 2041
2055	Deposition of Donald Tilton, dated December 17, 2020, Depo. Exhibit 2042
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2060	Deposition of Donald Tilton, dated December 17, 2020, Depo. Exhibit 2047
2061	Deposition of Donald Tilton, dated December 17, 2020, Depo. Exhibit 2048
2062	U.S. Pat. App. No. 13/401618 as filed on February 12, 2012

I. INTRODUCTION

Patent Owner respectfully requests the Board find that Petitioner has not shown by a preponderance of the evidence that the challenged claims are unpatentable. Petitioner's Ground 1 relies on Bezama to challenge independent claim 1 and its dependent claim 9, and Ground 2 adds Lyon to Bezama to challenge those same claims. Ground 3 challenges dependent claims 2, 4, and 5 based on Chiang and Bezama, and Ground 4 adds Lyon to Chiang and Bezama to challenge those same claims. Grounds 5 and 6 challenge clams 13, 14, and 15 based on Kang and Anderson, respectively. All combinations have several fatal flaws, detailed below.

II. TECHNOLOGY BACKGROUND

Patent Owner's Response is supported by the Declaration of Dr. Himanshu Pokharna (Ex. 2038, "Pokharna"), a qualified expert. (*See* Pokharna¶¶1-5, Ex. A.) Dr. Pokharna has provided an overview of the technology relevant to the '266 patent, reproduced in condensed form below. (*See id*., ¶¶29-31.)

A. Conventional Techniques in Electronics Cooling

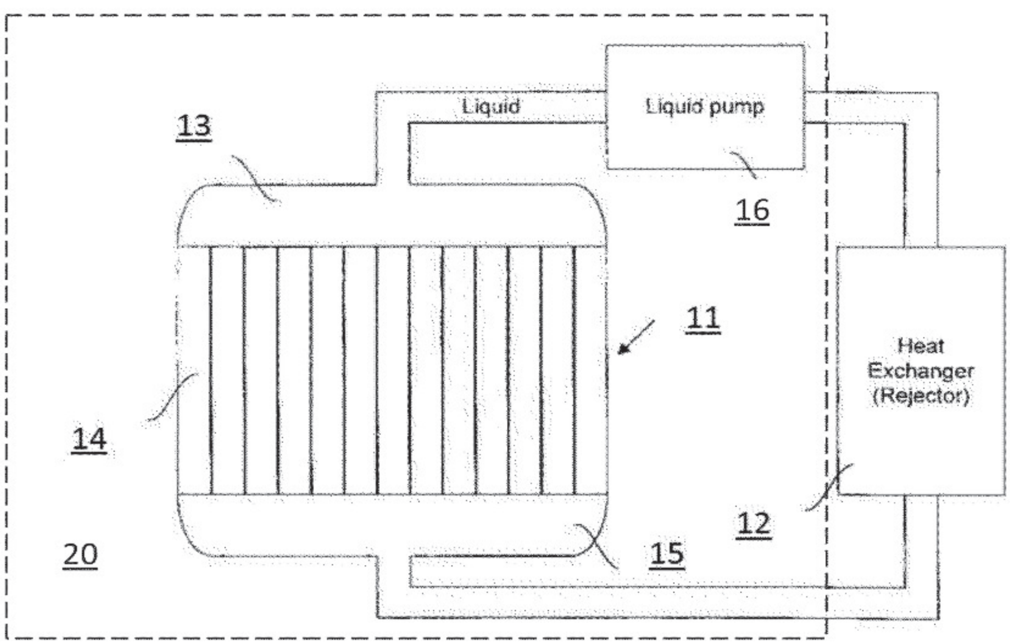
New generations of electronic devices (*e.g.*, microprocessors, graphics processors, and power electronics semiconductor devices) produce increasing heat during operation. If heat is not sufficiently removed, the devices can overheat,

resulting in decreased performance, reliability, and in some cases, component damage or failure. (Pokharna¶29.)

Industry has developed systems that use air cooling or liquid cooling to transfer and dissipate heat from electronic devices to an ultimate heat sink, like air. (*Id.*, ¶30.) Conventional air cooling uses a fan mounted near a heat-producing device to replace heated air with cooler ambient air.

B. Liquid Cooling Technologies for Electronics

Liquid cooling improves cooling performance compared to air cooling, as liquids such as water have significantly better heat transfer capabilities than air. (Pokharna¶28.) FIG. 1 of the '266 patent provides a block diagram of various components of a liquid cooling system:



('266, FIG. 1, Pokharna¶28.) The system typically operates by: (1) transferring heat from the heat-generating electronic devices to a cool liquid passing through a heat exchanger placed in thermal contact with a heat-generating device (not shown); (2) transporting the heat absorbed by the liquid to a remote radiator, or heat rejector; (3) dissipating the heat into air passing through the remote radiator; and (4) returning cooled liquid to the heat exchanger. ('266, 6:56-67; Pokharna¶28.)

III. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art in the context of the '266 patent (around 2007 to 2011) would have earned at least a bachelor's degree, such as a B.S. (bachelor of science), or equivalent thereof, in mechanical engineering or a closely-related field and possessed at least three years of specialized experience in heat transfer devices for thermal management in electronics and computer systems, or in similar systems. (Pokharna¶23.)[1]

[1] Patent Owner's arguments herein, and Dr. Pokharna's opinions on patentability of the challenged claims, remain unchanged under Dr. Tilton's definition of a POSITA. (Pokharna¶9.)

IV. SUMMARY OF THE '266 PATENT, PROVISIONALS, AND RELEVANT PROSECUTION HISTORY

A. '266 Patent [Ex. 1001]

The '266 patent describes at least two main embodiments of heat exchangers: e.g., FIGS. 6 and 7, below:

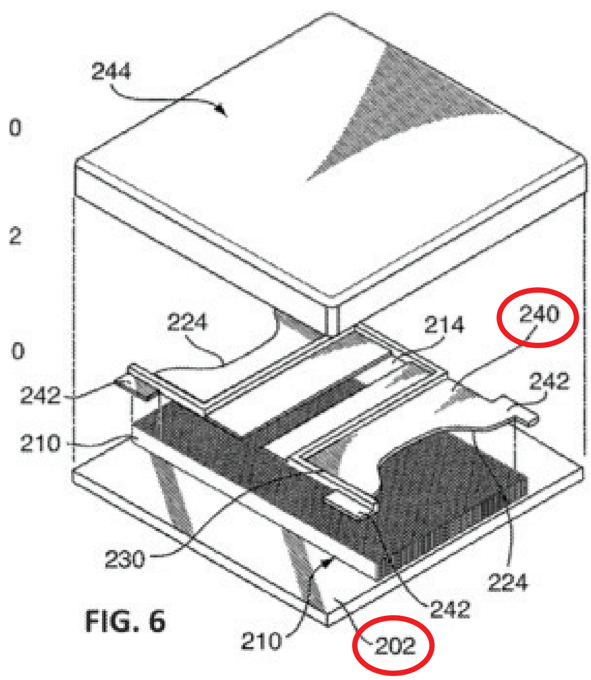


FIG. 6

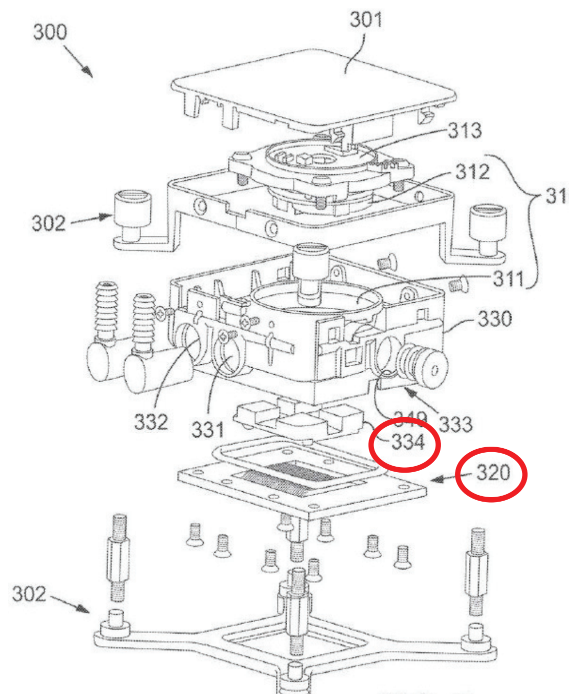
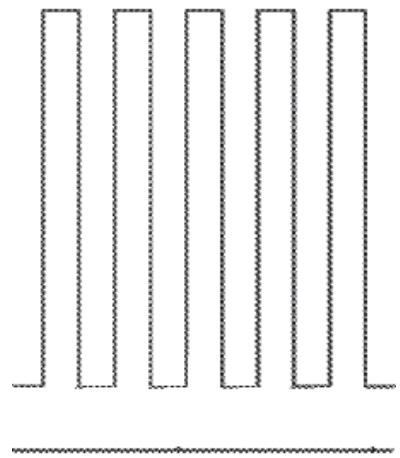
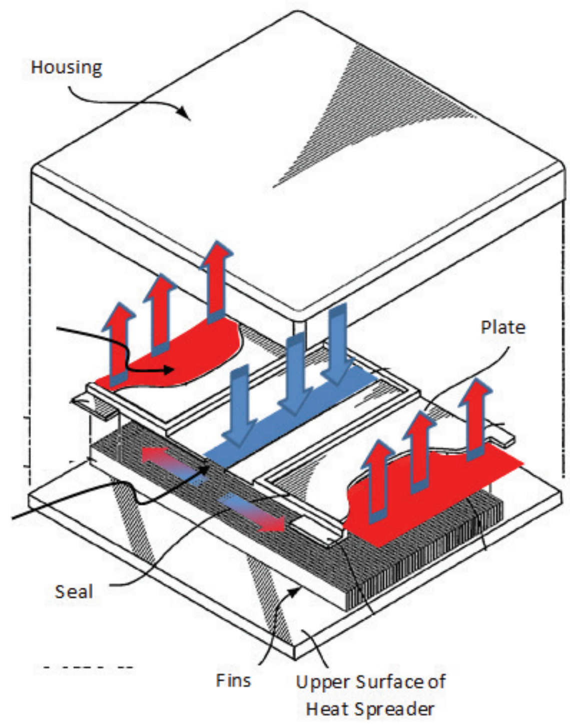


FIG. 7

Both heat exchanger embodiments include a heat spreader plate (**202** in FIG. 6 and **320** in FIG. 7) that is placed in contact with a heat-generating device to transfer heat dissipated by the device to a fluid passing through the heat exchanger. ('266, 6:56–64; Pokharna¶20.) To improve heat-transfer efficiency, fins extend upward from an upper surface of the heat spreader plate, defining microchannels between the fins, as shown in FIG. 17 of the '266 patent (excerpt reproduced on right). ('266, 8:36-44, 17:14-20; Pokharna¶30.) Heat absorbed by the heat spreader plate spreads into the fins and fluid passing through the microchannels absorbs the heat from the fins. ('266, 8:52-54; Pokharna¶20.)



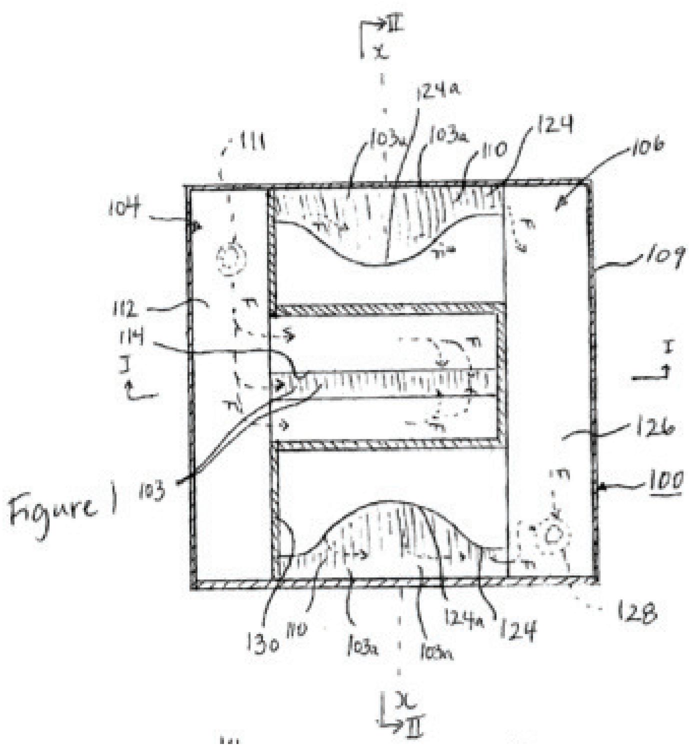
In either embodiment, as fluid passes through the heat exchanger, a manifold plate (**240** in FIG. 6 and **334** in FIG. 7) overlies the fins and microchannels and guides the fluid into the microchannels from above. (Pokharna¶31.) In the annotated version of FIG. 6 to the right, cool fluid (**blue**) enters the microchannels and heated fluid (**red**) leaves the microchannels, with arrows showing the direction of bulk fluid motion through the heat exchanger. (Pokharna¶21.) As the flow of cool fluid enters the microchannels, the flow splits, or bifurcates, outwardly from the inlet (**blue**) toward the outlets (**red**), where the warm fluid collects and exhausts from the heat exchanger. (*See* '266, 6:65-7:16; Pokharna¶31.)



B. 2007 Provisional [Ex. 1005]

U.S. Provisional App. No. 60/954,987 (the "2007 Provisional") discloses heat exchangers described in connection with, *e.g.*, FIG. 6 of the '266 patent. (Pokharna¶33.) The '266 patent renumbers formal versions of Figures 1-5 from the 2007 Provisional as FIGS. 2-6, respectively. (*Id.*)

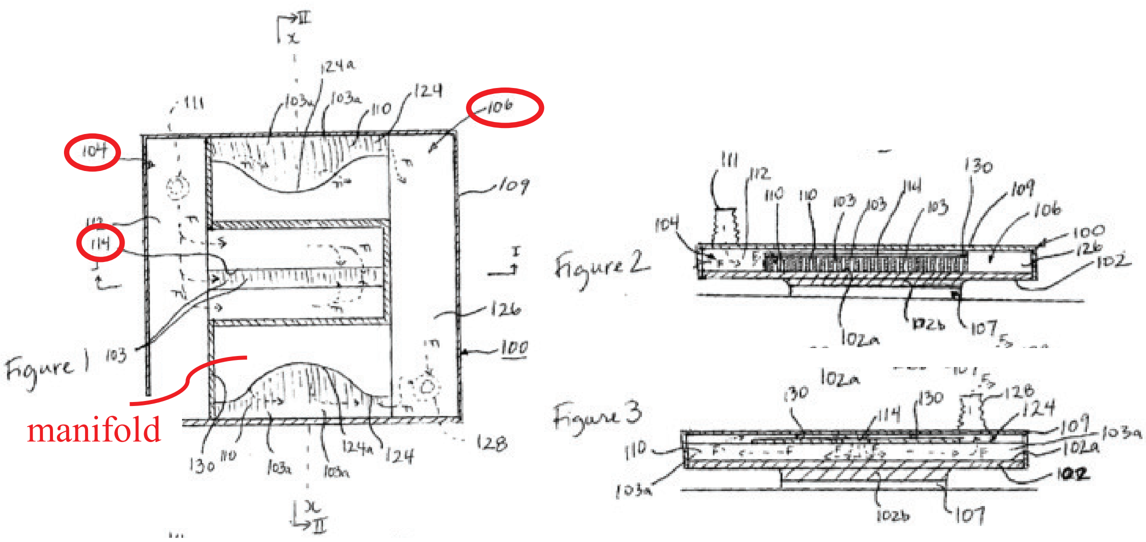
Heat exchangers in the '266 patent share many aspects of heat exchangers described in the 2007 Provisional. (*Id.*, ¶33.) Figures 1-3 in the 2007 Provisional discloses an embodiment of a fluid heat exchanger **100**, including details of the flow path through the fluid heat exchanger. (*Id.*) Fluid heat exchanger **100** in Figure 1 is analogous to fluid heat exchanger 100 in FIG. 6 of the '266 patent, and is depicted below:



(2007 Provisional, Fig. 1; Pokharna¶33.) As shown, fluid heat exchanger **100** has a portion of housing lid **109** removed to reveal internal features. (2007 Provisional, 8; *see also* '266, 5:33-35; Pokharna¶34.) The arrows labeled "F" show the direction

of bulk fluid movement at various positions within the heat exchanger. (2007 Provisional, 13; *see also* '266, 11:50-54; Pokharna¶34.)

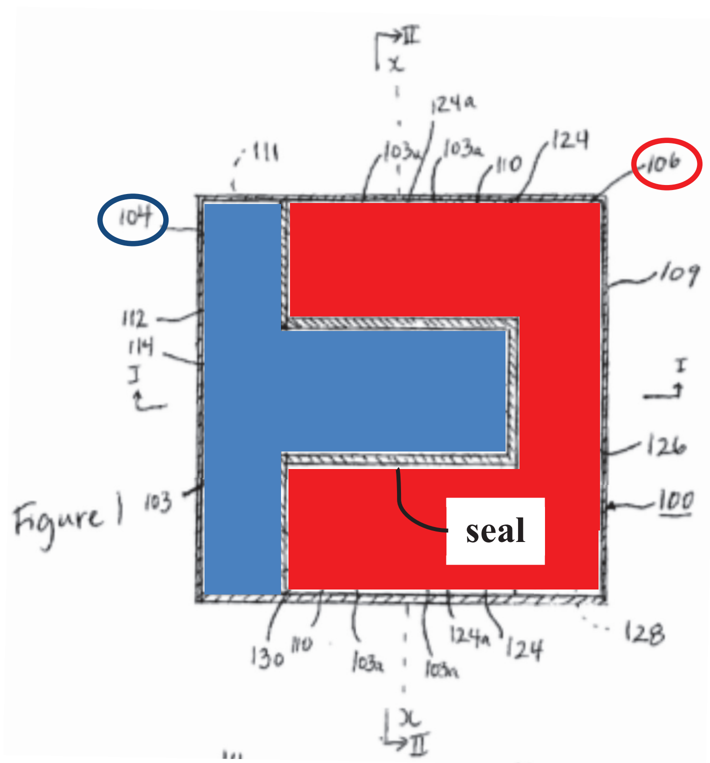
As can be seen in Figures 1-3 of the 2007 Provisional, the fluid heat exchanger **100** includes a heat spreader plate **102** that has a contact region **102b** underneath:



(2007 Provisional, Figs. 1-3, Pokharna¶35.) The contact region **102b** is in contact with a heat source **107** (*e.g.*, a heat-generating electronic device). (2007 Provisional, 9; '266, 8:1-31; Pokharna¶35.) Heat spreader plate **102** also has an upward facing surface **102a**, from which a plurality of parallel walls **110** (fins) extend upwardly to form the microchannels **103**. (2007 Provisional, 9; '266, 8:32-44; Pokharna¶35.) Heat spreader plate **102** and parallel walls **110** absorb/remove the heat from heat generating source **107** and dissipate the heat into the heat exchanging fluid passing through microchannels **103**. (2007 Provisional, 9; '266, 8:49–52; Pokharna¶35.)

Fluid heat exchanger **100** includes a manifold plate (not separately labeled in Figures 1-3 but similar to plate **240** shown in Figures 4-5) to guide fluid along a segment of an inlet passage **104** into the microchannels through fluid inlet opening **114**, as the arrows F in Figures 1-3 indicate. (2007 Provisional, 13; '266, 11:50-54; Pokharna¶36.) Fluid inlet opening **114** is positioned adjacent to contact region **102b** of heat spreader plate **102** (Figures 2 and 3) to introduce the fresh heat exchanging fluid directly to the hottest region of the heat exchanger in contact with heat source **107**. (2007 Provisional, 11; '266, 9:62-66; Pokharna¶36.) That is, the heat exchanging fluid flows through fluid inlet opening **114** downwardly into a substantially middle region of microchannels **103** in a direction toward surface **102a**, beneath which contact region **102b** is in contact with heat source **107**. (2007 Provisional, 11; '266, 9:62-66; Pokharna¶36.) The heat exchanging fluid flows then split into two sub-flows sideways and change their directions to pass along the lengths of channels **103** substantially parallel to surface **102a**. (2007 Provisional, 11, Fig. 3 (showing the flows labeled as "F" near inlet opening **114**); '266, 11:9:62-66; Pokharna¶36.) Splitting the fluid flows "creates less back pressure and less flow resistance, allows faster fluid flow through the channels and lessens the pump force required to move the fluid through the heat exchanger." (2007 Provisional, 11; 2007 Provisional, 11:19-46.)

Fluid heat exchanger **100**'s manifold plate overlies and urges against the fins, closing off and defining a flow boundary of the microchannels. (*See* 2007 Provisional, 14; '266, 12:36-37, FIGS. 3-4; Pokharna¶37.) A fluid outlet passage **106** starts with one or more fluid outlet openings **124** from microchannels 103 and proceeds to the outlet header **126** and then outlet port **128** (indicated in FIG. 2 by the arrows labeled as "F" going from the openings **124** located near the two respective end-regions of the microchannels **103** towards the outlet port **128**). (2007 Provisional, 12-13; '266, 10:46-64; Pokharna¶37.)



As shown in Figures 1-3 and annotated Figure 1 directly above, a seal **130**[2] overlies the manifold plate and isolates the fluid inlet passage **104** (**blue**) from the fluid outlet passage **106** (**red**), forcing the fluid along the flow path described above. (2007 Provisional, 13; '266, 12:19-22; Pokharna¶38.) As seal **130** fills the gap, the heat exchanging fluid cannot bypass the microchannels as it flows from fluid inlet passage **104** to fluid outlet passage **106**, ensuring the heat exchanger functions as intended. (2007 Provisional, 13-14; '266, 12:19-22; Pokharna¶38.)

C. 2011 Provisional [Ex. 1006]

U.S. Provisional App. No. 61/512,379 (the "2011 Provisional") discloses additional heat exchanger embodiments that appear in, *e.g.*, FIG. 7 *et seq.* of the '266 patent and describe a mating engagement between a manifold insert and a housing. (Pokharna¶47.)

Unlike the earlier 2007 Provisional, expanded disclosure in the 2011 Provisional describes a housing and a corresponding manifold insert having complementary contours that permit the manifold insert and the housing to mechanically join or fit together to interlock. (2011 Provisional, 25:1-10, FIGS. 10-12; Pokharna¶48.) Such components and features are shown in the images appearing

[2] Seal **130** in Figures 1-3 is depicted as seal **230** in Figure 5.

in the 2011 Provisional as FIGs. 10 and 12, reproduced below:

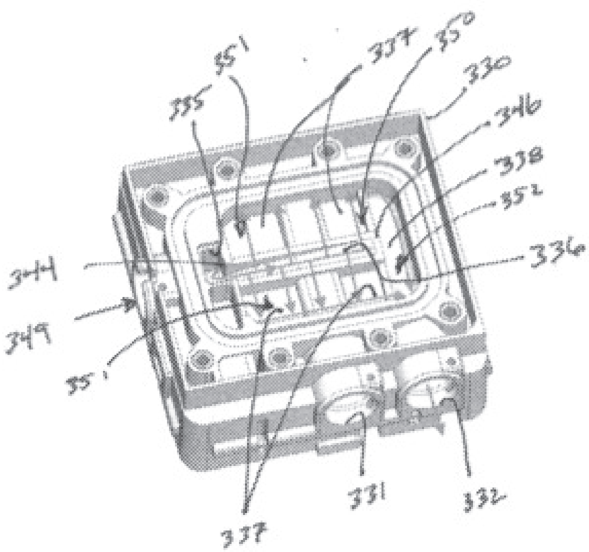


FIG. 10

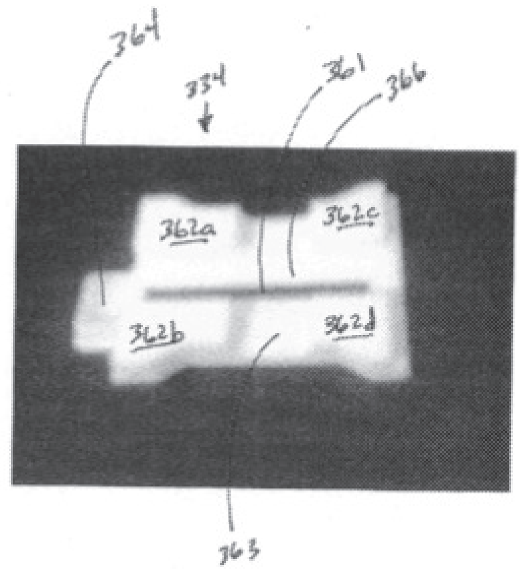


FIG. 12

(*Id*., FIGS. 10, 12; see *id.*, 25:1-10.)

D. Overview of Relevant File History

The '266 patent lists Kang [Ex. 1014] as cited during examination. ('266, 2.) After reviewing Patent Owner's submitted IDS during prosecution, the Examiner indicated that he considered Kang – its listing is not lined through. (Ex. 1002, 104; *see also id.*, 128 (showing Kang in search strategy).) The '266 patent also lists U.S. Pub. No. 2007/0163750 ("Bhatti") [Ex. 2028] as cited during examination ('266, 3), as confirmed by the '266 file history. (Ex. 1002, 42-46.)

Anderson is substantially similar to Bhatti and both references share the same assignee, Delphi Technologies, Inc. Both Anderson and Bhatti concern liquid-

cooled heat sinks, with Bhatti being directed to the device and Anderson being directed to methods of manufacturing the device. (Anderson, [0001], cls. 1-11; Bhatti, [0001], cls. 1-6; Pokharna¶53.) A comparison of FIG. 2 (left) from Anderson with FIG. 3 (right) from Bhatti shows the stark similarities:

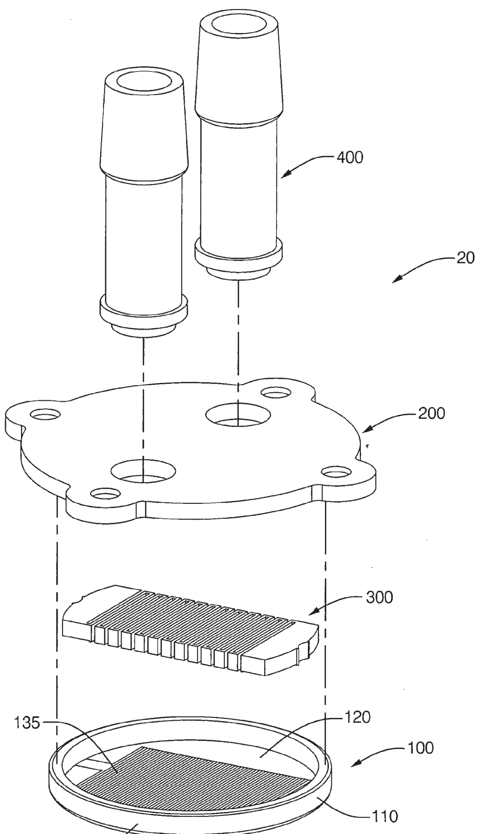
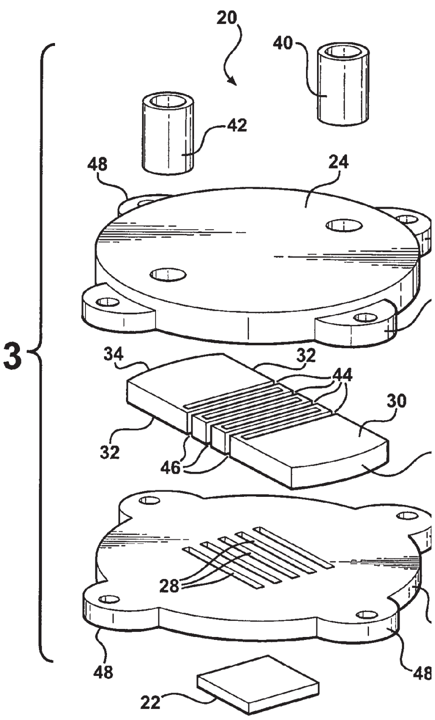


FIG. 2

FIG - 3



The flow through both devices also is substantially identical. (Anderson, FIGs. 5A, 5B; *cf.* Bhatti, FIGS. 4-5; Pokharna¶54.) Anderson and Bhatti both also describe using gaskets between parts. (Anderson, [0010]; Bhatti, [0019]; Pokharna¶54.) Anderson describes using recast metallic particles from a laser-

machining process as a compliant gasket material between the fins (**135**) and a manifold plate **300** and Bhatti does not describe using such recast material to form a gasket. (Pokharna¶54.) However, the '266 patent also does not pertain to laser machining or recast material. (*Id.*) Accordingly, Patent Owner submits there are no material differences between Anderson and Bhatti as it pertains to Claims 13-15. (*Id.*)

V. CLAIM CONSTRUCTION

Patent Owner requests the Board construe the claim term "seal" and adopt the stipulated construction of "microchannels." Patent Owner also responds to Petitioner's proposed constructions of other terms.[3]

A. "exhaust manifold"

The Board need not construe "exhaust manifold" because construction of this term is immaterial to the validity dispute here. (Paper 12 at 18, (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999), *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).) Nevertheless, in concurrent litigation between Petitioner and Patent Owner,

[3] The Board construes claims in *inter partes* review using the same *Phillips* standard as applied in district court. (*See* Paper 12, at 16 (citing 37 C.F.R. § 42.100(b)(2018).)

Petitioner proposed the same construction of "exhaust manifold" as it now presents in the Petition. (Pet. 9-11; Ex. 2014, 21:11-23:18.) After briefing and a claim construction hearing, the district court rejected Petitioner's construction, under the same standard as the Board now applies, and adopted Patent Owner's construction. 37 C.F.R. § 42.100(b). (Ex. 2029, 25-29; *see also* Ex. 2012-2017.) Because Petitioner merely rehashes its arguments for a construction already rejected by the district court, Patent Owner respectfully submits that, if the Board construes "exhaust manifold," it should adopt the district court's well-reasoned construction of "**a space into which the collected liquid flows**." (Ex. 2029, 25-29; Pokharna¶56.) *E.g., Apple Inc. v. OpenTV, Inc.*, IPR2015-00969 (Paper 8), at 9-10 (P.T.A.B. Sept. 23, 2015) ("Although we are not bound by the District Court's constructions, we consider its reasoned analysis, especially because we are applying the *Phillips* standard ordinarily used by district courts."); *Western Digital Corp. v. SPEX Techs., Inc.*, IPR2018-00082 (Paper 11), at 13-16 (P.T.A.B. Apr. 25, 2018) (adopting district court constructions where same *Phillips* standard applied). *Cf. Power Integrations, Inc. v. Lee*, 797 F.3d 1318, 1326 (Fed. Cir. 2015)

B. "aperture in the plate"

Similarly, in concurrent litigation between Petitioner and Patent Owner, Petitioner propounded essentially the same construction of "aperture" and

supporting arguments as it presents in the Petition, except the Petition adds "in the plate." (Pet., 11-12; Ex. 2014, 12:3-15:2; Pokharna¶57.) The district court rejected Petitioner's construction of "aperture" after briefing by the parties and applying the same standard of claim construction as the Board applies. 37 C.F.R. § 42.100(b). (Ex. 2029, 33-36; *also see* Ex. 2012-2017.) Patent Owner respectfully submits the Board also should reject Petitioner's proposed construction and instead construe that phrase in accord with its plain and ordinary meaning as the district court did for "aperture." (Ex. 2029, 33-36; Pokharna¶57.)

C. "outlet opening"

Again, Petitioner merely recycles its construction of "outlet opening" and supporting arguments already rejected by the district court applying the same claim construction standard as used by the Board. (Pet. 13; Ex. 2014, 33:8-36:17.) Accordingly, Patent Owner respectfully submits the Board also should reject Petitioner's proposed construction of "outlet opening" and instead construe that phrase in accord with its plain and ordinary meaning as the district court did. (Ex. 2029, 36-38; Pokharna¶58.)

D. "seal"

Again, Petitioner merely recycles its construction of "seal" and supporting arguments already rejected by the district court applying the same claim construction

standard as used by the Board.[4] (Pet. 13-15; Ex. 2014, 28:12-33:7.) Accordingly, Patent Owner respectfully submits the Board also should reject Petitioner's proposed construction and instead adopt the district court's well-reasoned construction of "seal" as "**a component that fills a gap to prevent leakage through the gap**." (Ex. 2029, 42-44; *also see* Ex. 2012-2017; Pokharna¶59.)

A POSITA reviewing the intrinsic record would have readily apprehended that a "seal" is "a component that fills a gap to prevent leakage through the gap" rather than a state of being sealed as Petitioner proposes. (Pokharna¶60; Ex. 2011, 42-45; Ex. 2013, 29-32.) That is, a "seal" is a structure, not just a state. (Pokharna¶60; Ex. 2002, 3, 5-6, Fig. 1 (describing an O-ring gasket as a "sealing ring"); Ex. 2011, 42-45; Ex. 2013, 29-32.) The claim language itself connotes structure. Claim 13 recites "a seal, wherein the seal is a <u>portion of the plate.</u>" The specification also consistently uses the term "seal" to refer to a component having a three-dimensional structure. With reference to FIG. 6, the specification states: "Seal

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[4] Petitioner also changed its position during claim construction briefing and proposed an amended construction, different from the construction it proposes in the Petition. (Ex. 2029, 42.) Petitioner proposed this amended construction on January 24, 2020 (Ex. 2014, 28), prior to the date it filed its Petition on April 10, 2020.

230 may be installed as a portion of plate 240 or separately." (*See* '266, 12:43-44; 13:15-20 ("A seal (e.g., an O-ring **323** can be positioned between the housing **330** and the heat exchanger **320** to reduce and/or eliminate leakage…"); Pokharna¶60.)

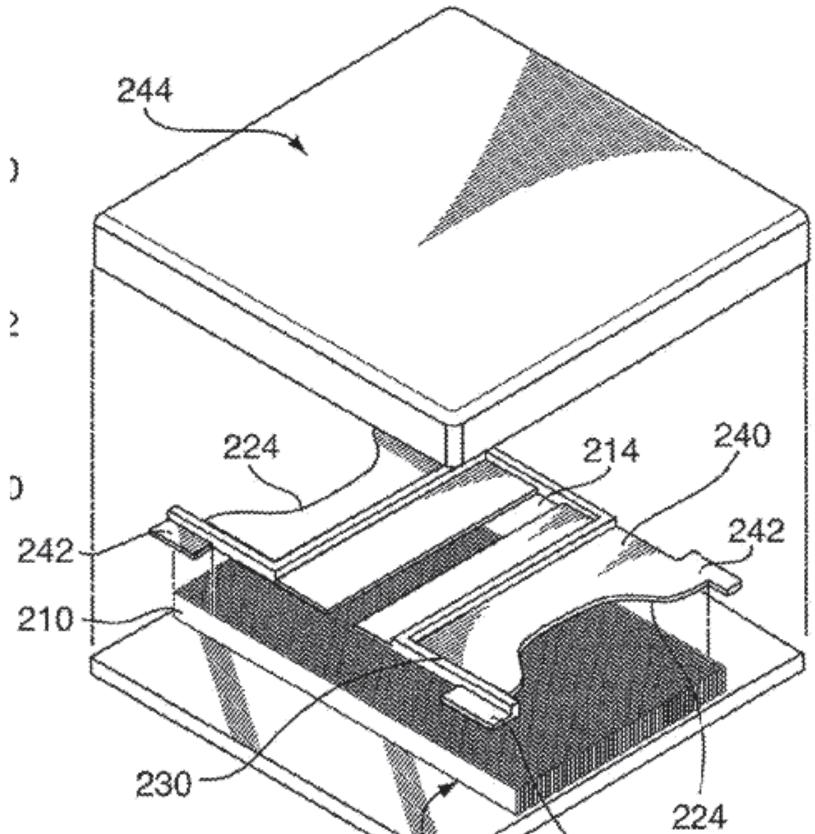
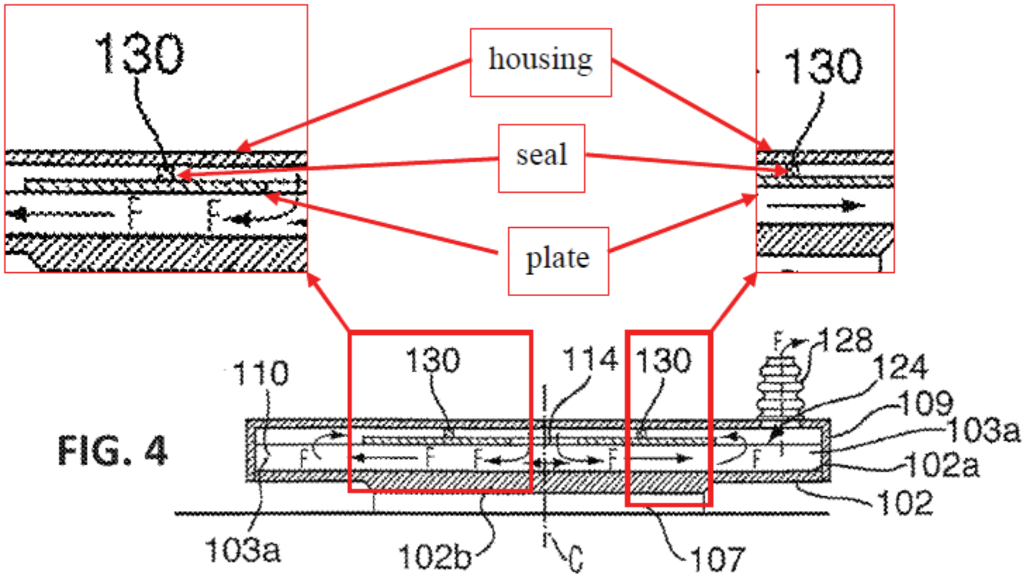


FIG. 6

Additionally, FIGS. 2-4 show an embodiment where the seal is separate from the plate and where seal **130** is clearly a three-dimensional structure similar to, *e.g.*, an O-ring or a gasket, that spans the gap from the unnumbered plate to an underside of the housing **109**:



('266, FIG. 4; Pokharna¶¶60, 43; Ex. 2003, 1.)

The specification provides further support for Patent Owner's proposed construction as it expressly refers to seal **230** as a "part," which a POSITA would have understood as being equivalent to the term "component," *e.g.*, a member having three-dimensional structure configured to fill a gap and prevent flow bypass.('266, 12:45-52; 2007 Provisional, 14; Pokharna¶61.) For example, the specification states: "After plate 240 and seal 230 are positioned, a top cap can be installed over the assembly [of the monolithic plate 240 and seal 230 overlying the fins 210]." ('266, 12:45-46; 2007 Provisional, 14; Pokharna¶61.) A POSITA would have known it makes no sense to "position" anything but a structural component during assembly. (Pokharna¶61.) The specification also explains that "[t]he parts [or

components] may be connected during assembly thereof or afterward by overall fusing techniques. In so doing, the parts are connected …." ('266, 12:48-50; 2007 Provisional, 14; Pokharna¶61.) That is, the seal is still a component regardless of whether a fusing technique is used.

Accordingly, in view of the claim language and specification, a POSITA would have understood "seal" to mean "**a component that fills a gap to prevent leakage through the gap**." (Pokharna¶62.)

E. "Microchannels"

In concurrent litigation between Petitioner and Patent Owner, Petitioner and Patent Owner stipulated that the claim term "microchannels" means "channels with widths up to 1 millimeter." (Ex. 1009, 3.)

VI. CHALLENGED CLAIMS 1, 2, 4, 5, AND 9 ARE ENTITLED TO PRIORITY TO THE 2007 PROVISIONAL[5]

Petitioner alleges that Claims 1, 2, 4, 5, and 9 lack written description support in the 2007 Provisional and '330 patent (which matured from the application

[5] Petitioner does not challenge the benefit of priority enjoyed by Claims 13-15.

published as Lyon 2009 relied upon in Petitioner's Ground 2),[6] and cannot claim priority to their respective filing dates. (Pet., 17-18, 20.) Petitioner rests its written description challenge on arguing that the 2007 Provisional / '330 patent lack disclosure to support a "manifold body defin[ing] a pair of compliant surfaces" in claim 1. (Paper 2, 17-18 (alteration in original); Paper 12, 18.) However, a POSITA would have recognized that the 2007 Provisional has ample disclosure to support this limitation.

A. The 2007 Provisional reasonably conveys to a POSTITA that the inventor possessed a plate 240 made from a compliant material by August 9, 2007

Petitioner's priority challenge reduces to whether the 2007 Provisional *reasonably* conveys to a POSITA that the inventor had possession of a manifold body made from a "compliant" material. (Pet., 18-20.) *Ariad Pharm., Inc. v. Eli*

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[6] The '330 patent matured from U.S Patent App. No. 12/189,476, which published as Lyon 2009. (Ex. 1004 at 1, codes (21) and (65); Lyon 2009, at 1, codes (21) and (60).) The subject matter disclosed in the '330 patent fully incorporates the subject matter disclosed in Lyon 2009. Moreover, the Petition does not distinguish between or among subject matter disclosed in the 2007 Provisional, Lyon 2009, and the '330 patent.

Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc); s*ee*, *Blue Calypso v. Groupon, Inc.*, 815 F.3d 1331, 1344-1345 (Fed. Cir. 2016) (the written description inquiry under Section 112 imposes no *in haec verba* requirement).[7]

In its Institution Decision, based on the initial record and with Patent Owner previously relying on the higher inherency standard, the Board sided with Petitioner's position. Patent Owner now provides a fuller identification and explanation of the record (not previously discussed in the Patent Owner's Preliminary Response) to demonstrate why disclosure in the 2007 Provisional reasonably would have conveyed to a POSITA that the inventor was in possession of a compliant manifold body.

As discussed in Patent Owner's Preliminary Response, the 2007 Provisional discloses a monolithic plate **240** and seal **230**. (Paper 6, 18-21.) Patent Owner now further identifies bendable tabs **242**, which are monolithic with plate **240**. (2007 Provisional, 14:6-7 ("Tabs **242** may be used to assist with the positioning and

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[7] Patent Owner's Preliminary Response argued that the continuous, monolithic structure defining seal **230** and plate **240** in Figures 4-5 of the 2007 Provisional were *inherently* compliant. However, the written description inquiry does not require inherency under *Ariad*.

installation of plate **240**, wherein tabs **242** are bent down over the two outermost walls.").) As tabs **242** are bendable and compliant, a POSITA would have understood the rest of monolithic, continuous plate **240** to be equally bendable and compliant. (Pokharna¶66.) The 2007 Provisional's disclosures support this understanding. Figure 5 depicts tabs **242**, plate **240**, and seal **230** as a continuous and monolithic member:

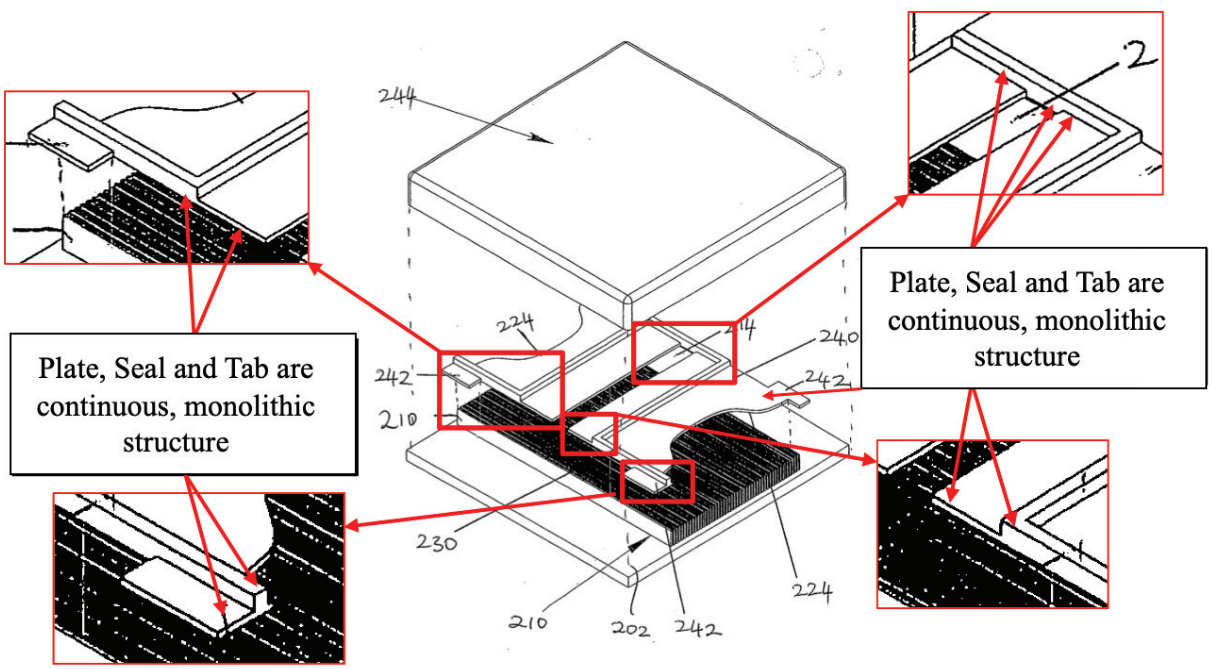


Figure 5

(2007 Provisional, Fig. 5; *see also* Pokharna¶66; Tilton Depo., 12/19/20, 117:5-118:1.) The 2007 Provisional also discloses that seal **230** is monolithic with plate **240** and tabs **242**. The Institution Decision recognizes that "[i]t certainly is possible

that seal 230 and plate 240 could be made of a compliant material." But the Institution Decision notes that "the 2007 Provisional also discloses that a seal could be formed by connecting top cap 244 and seal 230 using 'fusing techniques.'" (Paper 12, 20). It is precisely because the 2007 Provisional also discloses non-fusing techniques for sealing[8] that a POSITA would have understood the monolithic seal and plate to be compliant.

The 2007 Provisional recites that a primary function of plate **240** is to "close off the channels across the upper limits of walls **210**," – *i.e.*, to provide a gasketing or sealing function. (2007 Provisional, 14:4-5; Pokharna¶67.) From this statement, a POSITA would have clearly recognized that the inventor was in possession of a

[8] The 2007 Provisional states: "The parts may be connected during assembly thereof or afterward by overall fusing techniques." (2007 Provisional, 14:11.) A POSITA would have recognized that applying "overall fusing techniques" to a device only makes sense after the device has been assembled and that "overall fusing techniques" would not be applied during assembly. (*Id.*) Accordingly, a POSITA would have understood that sentence to provide two alternative assembly methods: (1) the parts may be connected during assembly; or (2) the parts can be connected by overall fusing techniques after assembly. (Pokharna¶67, FN8.)

"compliant" plate **240**, even if that term was not expressly used in the 2007 Provisional. (Pokharna¶67.) Seals made from compliant materials were notoriously well-known long before August 9, 2007. (Pokharna¶¶67-68; Ex. 2002, 1474, 1476-77, Fig. 1; Ex. 2003; Ex. 2043, *Standard Handbook of Machine Design* (2d Ed. 1996), 5-6.). It is axiomatic "that a specification need not disclose what is well-known in the art." *See Toyota Motor Corp. v. Gen. Elect. Co.*, IPR2019-00012 (Paper 35), at 18-20 (P.T.A.B. Apr. 1, 2020) (citing *Streck, Inc. v. Research & Diagnostic Sys., Inc.*, 665 F.3d 1269, 1288 (Fed. Cir. 2012)). "Given this perspective, in some instances, a patentee can rely on information that is 'well known in the art' to satisfy written description." *Streck*, 665 F.3d at 1285. Thus, a POSITA clearly would have recognized that the inventor was in possession of a compliant continuous, monolithic structure that included plate **240**.

B. Disclosure of "fusing techniques" in the 2007 Provisional is also consistent with plate 240 being made from a compliant material

Further, the disclosure in the 2007 Provisional pertaining to "fusing techniques" is consistent with a determination that a POSITA would have recognized that the inventor was in possession of a compliant plate **240**. (Pokharna¶70.) As a threshold matter, Petitioner's expert acknowledged that an elastomeric seal **230** can be fused with a plastic housing. (Tilton Depo., 12/19/20,

115:15-19; Pokharna¶70.) In addition to elastomeric seals, metallic seals (*e.g.*, formed of soft copper or soft aluminum) are also compliant and can be fused with a housing. (Pokharna¶70.) For example, soft alloys of copper or aluminum can be soldered or brazed with a metallic housing. (*Id.*)

C. Added disclosure in the 2011 Provisional and the '266 patent is consistent with plate 240 being made from a compliant material

The added disclosure of the 2011 Provisional (and the '266 patent) largely concerns features that permit the earlier heat exchanger from the 2007 Provisional to be combined with a pump to provide a single, integrated heat exchange system. (2011 Provisional, 21:1-22:7; Pokharna¶71.) With respect to insert **334**, this new subject matter focuses on new structural features that permit the insert to be "matingly engaged" with the housing, in addition to features that could improve flow through the heat exchanger. (*Id.*, 24:12-23:12.; Pokharna¶71.)

Notably, the 2011 Provisional makes clear that plate **240** and insert **334** perform equivalent functions: they both overlie the fins and define an upper flow boundary of the microchannels. (2011 Provisional, 22:22-26; 2007 Provisional, 14:4-8; Pokharna¶72.) The 2011 Provisional also discloses fins with beveled edges, which can arise when forming the fins, and blunt fins, which typically require a subsequent machining step. (2011 Provisional, FIGS. 16, 17); Pokharna¶72.) In

that context, the 2011 Provisional states: "The conformable surfaces **367** [of insert **334**] can reduce or eliminate the need for secondary machining operations to make the respective distal ends of the fins generally coplanar and compatible with, for example, the plate **240**." (2011 Provisional, 22:22-23:5; Pokharna¶72.) From that statement, and in keeping with general principles of material behavior, a POSITA would have simply understood that the relatively thicker insert **334** that matingly engages with the housing can undergo larger absolute deformations than the relatively thinner plate **240** that is merely compressed between the housing and the fins, and thus can accommodate larger variations in fin height than plate **240**. (Pokharna¶72; Handbook, 3 (discussing material choice in light of compressibility.).)

On filing the first non-provisional application from the 2011 Provisional, Patent Owner revised that sentence to read: "The conformable surfaces 367 can reduce or eliminate the need for secondary machining operations to make the respective distal ends of the fins generally coplanar and compatible with, for example, a rigid plate." (Pokharna¶73.) But Petitioner reads much more into this minor editorial change than a POSITA would have in the context of the whole disclosure across various filings in this patent family. (Pokharna¶73.) Based on that minor revision, a POSITA would not have interpreted plate **240** to be a rigid plate,

but rather would have understood the revision to emphasize additional benefits of a thicker insert **334** that matingly engages the housing of the pump. (Pokharna¶73.) Moreover, Petitioner's focus on this revision ignores that the priority inquiry turns on whether the ***2007 Provisional*** would have ***reasonably*** conveyed to a POSITA that the inventor had possession of a compliant manifold body. As shown, a POSITA would have clearly recognized the disclosure of a compliant manifold body.

D. Dr. Tilton's inconsistent testimony should be accorded little weight

Dr. Tilton provided shifting and inconsistent testimony on compliant manifold bodies between his Declaration and subsequent depositions. His testimony on this issue should be accorded little weight. *F5 Networks v. Radware, Ltd.*, IPR2017-00124 (Paper 48), at 55 (P.T.A.B. Apr. 23, 2018) (inconsistent expert testimony undermines its credibility and is entitled to little weight); *Xilinx, Inc. v. Intellectual Ventures I LLC*, IPR2013-00029 (Paper 49), at 36 (P.T.A.B. Mar. 10, 2014).

In his Declaration, Dr. Tilton quotes Bezama as disclosing a separator sheet **303** "composed of a compliant flexible plastic or polymer material." (Ex. 1003 ("Tilton Decl."), ¶67 (quoting Bezama, [0028], [0031]); Pokharna¶75.) Indeed, Paragraph [0028] of Bezama makes clear that "separator sheet **303** can be composed of a compliant flexible plastic or polymer material such as a fluoroelastomer,

silicone elastomer, etc., or be composed of a combination of layers where a compliant flexible polymer layer or layers are stacked with a thin metallic sheet." (Bezama (underlining added).) In other words, Bezama teaches that a compliant separator sheet can be made of (1) only compliant material, or (2) layers of compliant and rigid materials. Dr. Tilton's Declaration only identifies the first embodiment. (Tilton Decl., ¶101; Pokharna¶75.) Dr. Tilton acknowledges that the separator sheet is positioned between the tops of Bezama's fins and cover and is described in Bezama as being able to prevent or minimize fluid flow between the fins and Bezama's manifold port **304**. (Tilton Decl., ¶¶67, 78, 79.) Finally, Dr. Tilton concludes that a POSITA would have found it obvious from Bezama's disclosure to "modify the *Lyon* heat exchanger to have the plate positioned on top of the microchannel walls 110 be compliant." (*Id.*, ¶102; *also see id.*, ¶¶103-105 (alleging compliant plate in *Lyon* would be obvious).)

Yet during deposition, when asked about whether Lyon 2009's plate could be compliant, Dr. Tilton took a contrary position – that making Lyon 2009's plate compliant would actually render Lyon's device inoperable. (Tilton Depo., 12/19/20, 122:11-123:16 ("If plate 240 was compliant like the seal, the plate would just bend up and the fluid would come out of the grooves. There would be no way to contain the fluid in the grooves. You wouldn't get the fluid cooling that you need.").) Dr.

Tilton even maintained his position on redirect. (*Id.*, 124:23-126:9.) Given the inconsistency in Dr. Tilton's positions, his testimony on whether a compliant manifold body is disclosed should be given little weight.

VII. THE CHALLENGED CLAIMS ARE PATENTABLE

Petitioner challenges Claims 1, 2, 4, 5, and 9 of the '266 patent. For the reasons discussed below, Petitioner has not met its burden of showing unpatentability by a preponderance of the evidence for any of its Grounds.

A. Brief Summary of Alleged Prior Art Cited in Petition

1. Bezama [Ex. 1010]

U.S. Patent App. Pub. No. 2010/0012294 to Bezama has a priority date of July 21, 2008. As the Challenged Claims are entitled to the August 9, 2007 priority date of the 2007 Provisional (*see supra*, Section VI), Bezama is not prior art.

2. Lyon [Ex. 1011]

U.S. Patent App. Pub. No. 2009/0071625 to Lyon ("Lyon 2009") shares disclosure with and claims priority to the 2007 Provisional. As the Challenged Claims are also entitled to the priority date of the 2007 Provisional (*see supra*, Section VI), Lyon 2009 is not prior art.

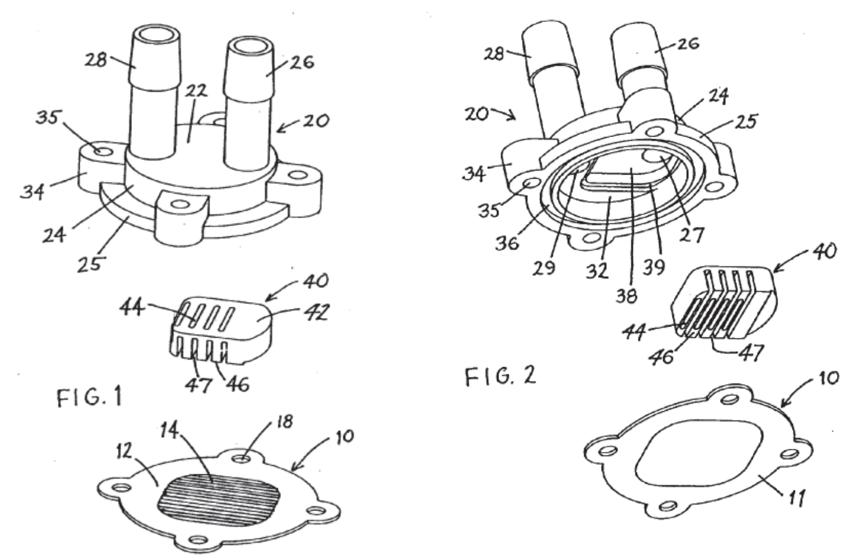
3. Chiang [Ex. 1013]

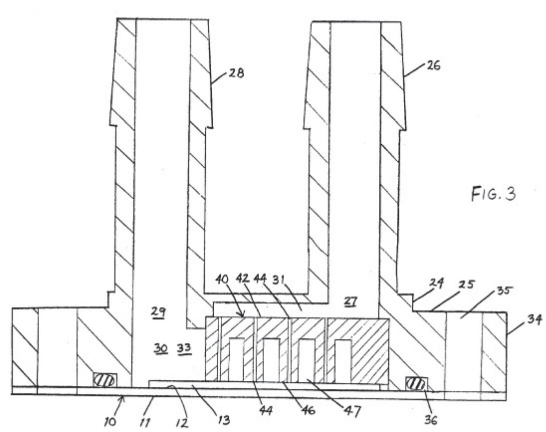
U.S. Patent No. 7,688,589 to Chiang has a priority date of November 1, 2007.

As the Challenged Claims are entitled to the August 9, 2007 priority date of the 2007 Provisional (*see supra*, Section VI), Chiang is not prior art.

4. Kang [Ex. 1014]

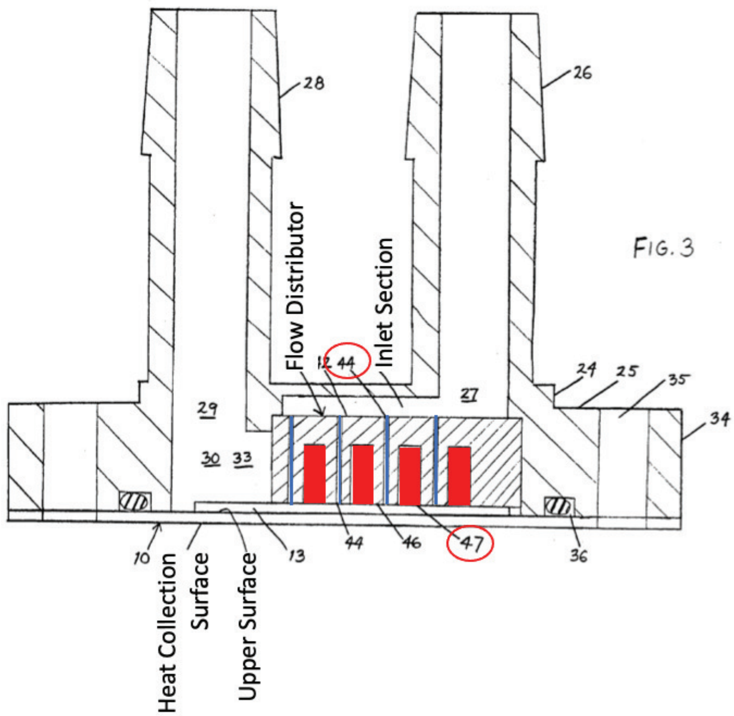
Kang discloses a liquid cold plate heat exchanger. (Kang, [0003].) Petitioner relies on Kang's heat exchanger shown in FIGs. 1-3, reproduced below:





(*Id*., FIGS. 1-3; *see also id*., [0019]-[0022]; Pokharna¶80.) Kang's device includes a cooling plate **10** having a heat collection surface **11** for placing against an object to be cooled and opposing heat transfer surface **12**. (Kang, [0028]; Pokharna¶80.)

An annotated version of FIG. 3, below, shows a cover **20** over the cooling plate **10** forming a chamber **30**, as well as an inlet nipple **26** and an outlet nipple **28**:



(Kang, FIG. 3 (annotated); Pokharna¶82.) Cover **20** also defines a first recess **32** (depicted in FIG. 2) and, from the bottom of that first recess, a second recess **38**. (Kang, FIG. 2; Pokharna¶82.) Second recess **38** defines a shoulder **39** against which a flow distributor **40** rests, spacing flow distributor **40** from the bottom of second

recess **38** to form an inlet section **31**. (*Id*.) Flow distributor **40** includes parallel slots **44** (in **blue** above) extending between the inlet section **31** and the outlet section **33**, and outlet channels **47** (in **red** above) that separate a plurality of coplanar lands spaced from heat transfer surface **12** by gaps **48**. (Kang, [0029]; Pokharna ¶82.) Fluid travels downward through the slots **44**, within the gaps **48** along the fins **13** and **14**, back up into the outlet channels **47,** and then along outlet channels **47** into outlet section **33**. (Kang, [0030].)

5. Anderson [Ex. 1015]

Anderson discloses an all-metal cold plate and a method of providing a metallic compliant gasket from an undesirable by-product of laser machining microchannels. (Anderson, Abstract, [0010], [0026]; Pokharna¶83.)

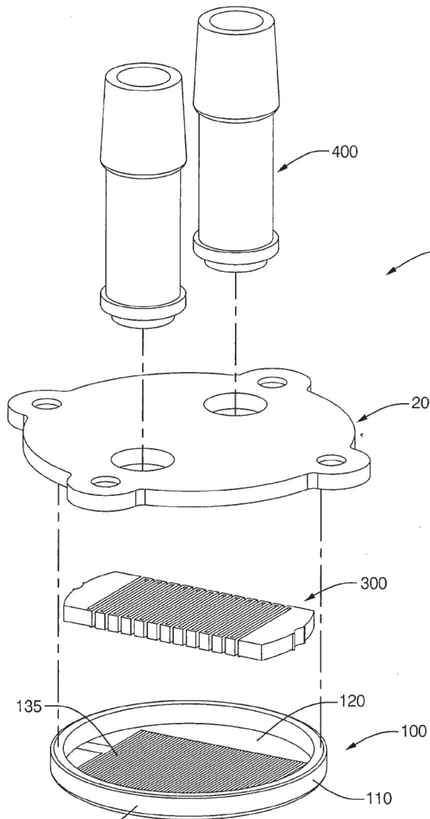


FIG. 2

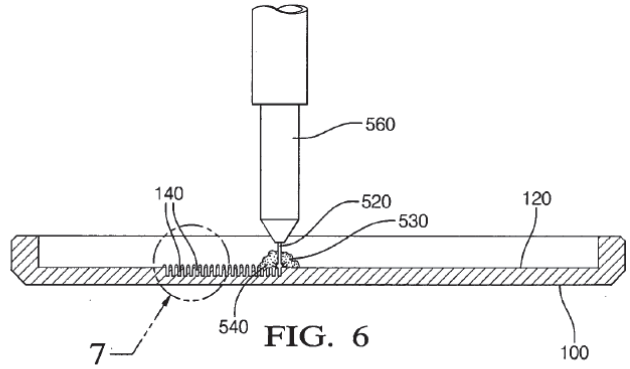


FIG. 6

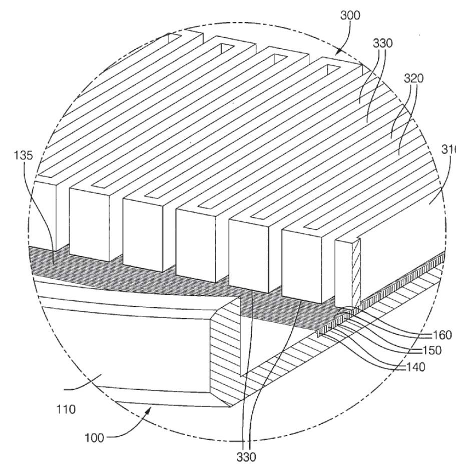


FIG. 4

Anderson's device includes a base plate **100** having laser-cut microchannels, a manifold cover **200** and a manifold plate **300** positioned between the laser-cut microchannels and the manifold cover. (Anderson, [0027]; Pokharna¶83.) Manifold plate **300** includes a sinuous wall **310** that forms a substantially rectangular pattern of side-by-side alternating channels **320** of constant width and height. (Anderson, [0030]; Pokharna¶83.)

FIGs. 5A and 5B depict the flow pattern provided by the manifold plate **300** and transverse microchannels in base plate **100**:

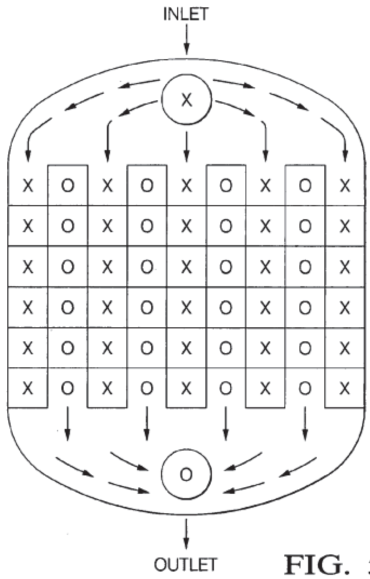


FIG. 5 A

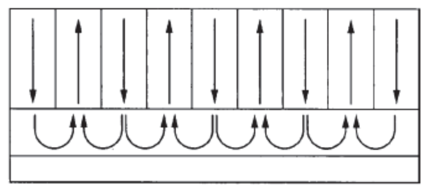


FIG. 5 B

(*Id.*, FIGS. 5A, 5B; *see also id.*, [0021], [0032].) In FIG. 5A, "X" indicates a coolant entry to the microchannels, and "O" indicates a coolant exit from the microchannels. (*Id.*, [0021], [0032]; Pokharna¶85.)

Anderson discloses laser micromachining a copper plate to form fin-channel pattern **135**. (*Id.*, [0035], FIG. 6; Pokharna¶86.) During that process, "the extremely high-energy input ablates the metallic base plate **100** at the point of contact by vaporizing the metallic mass into a plume **530** of aerosol microscopic particulate matter **540**." (*Id.*, [0035]; Pokharna¶86.) That plume of particulate matter condenses and coalesces, settling on coplanar edges **160** of the micro-fins **150** to form recast metal layer **500**. (*Id.*, [0036]; Pokharna¶86.) Rather than washing that recast metal layer away using an acid bath in accordance with previous

manufacturing practice, Anderson discloses using the recast by-product as a gasket between the fins and the manifold plate. (*Id.*; Pokharna¶86.)

B. Grounds 1-4 fail because Bezama, Lyon, and Chiang do not qualify as prior art to the Challenged Claims

As explained in Section VI, the Challenged Claims are entitled to the August 9, 2007 priority date of the 2007 Provisional. Bezama (July 21, 2008), Lyon 2009 (August 9, 2007), and Chiang (November 1, 2007) all fail to predate the priority date of the Challenged Claims, and accordingly, are not prior art.

C. Ground 5 fails to show how Claims 13-15 are obvious over Kang

Petitioner's challenge of Claims 13-15 based on the previously considered Kang is rife with deficiency. (Pokharna¶91.) First, Petitioner fails to show with particularity how Kang discloses all elements of the claims. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) ("In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.") (citing 35 U.S.C. § 312(a)(3)). Second, a POSITA would have been deterred from modifying Kang's device as proposed because doing so would render Kang's device unsuitable for its intended purpose – *i.e.*, enhancing heat transfer. *In re Fitch*, 972 F.2d 1260, 1265 n.12 (Fed. Cir. 1992). Lastly, Petitioner fails to explain why a POSITA would have been motivated to modify Kang's device.

Instead, Petitioner relies on impermissible hindsight reasoning and conclusory assertions from Dr. Tilton to support its proposed modification. *See Metalcraft of Mayville, Inc. v. The Toro Co.*, 848 F.3d 1358, 1367 (Fed. Cir. 2017) ("[The Court/agency] cannot allow hindsight bias to be the thread that stitches together prior art patches into something that is the claimed invention."); *Asetek Danmark A/S*, IPR2019-00705 (Paper 43), at 26-27 (finding unpersuasive Dr. Tilton's conclusory assertions supporting a proposed modification). Patent Owner addresses each deficiency below.

1. Kang does not teach a "seal," let alone a "seal [that] is a portion of the plate"

As discussed in Section V.D, the term "seal" as recited in Claim 13 ("a seal, wherein the seal is a portion of the plate") is properly construed as "a <u>component</u> that fills a gap to prevent leakage through the gap." (Ex. 2029, 42-44; Pokharna¶92.) Petitioner first identifies Kang's flow distributor **40** as the claimed plate. (Pet., 78-79; Pokharna¶92.) However, Kang's flow distributor **40** lacks any separately identifiable structure that can properly be considered as a *component* that fills a gap to prevent leakage through the gap. (Pokharna¶92.) Indeed, Petitioner merely relies on its construction of "seal" as a state of being sealed and alleges that "Kang's flow distributor 40 ('plate') is <u>press-fitted</u> into the shoulder 39 of cover 20 ('housing')

thereby sealing inlet section 31 from outlet section 33 and preventing coolant bypass between the inlet and outlet sides of the heat exchanger." (Pet., 79.) Petitioner commits a similar error in its first alternate mapping, claiming that shoulder **39** of cover **20** separates inlet section **31** from outlet section **33** and serves as a seal.[9] (*Id*., 80; Pokharna¶92.) Neither mapping accounts for how a seal must be a separate component. (Pokharna¶92.)

As another alternative, Petitioner posits that a POSITA would have known that a seal could be added to Kang's flow distributor **40** and "[i]t would have been a matter of engineering design choice to incorporate the 'seal' as a portion of flow distributor 40, for example, as a raised portion on the flow distributor." (Pet., 80-81.) But Petitioner provides no support for this assertion other than the uncorroborated and conclusory opinions from Dr. Tilton. (Tilton Decl., ¶173.) Dr. Tilton's *ipse dixit* testimony is insufficient and should be accorded little weight. *See Cephalon, Inc. v. Watson Pharms., Inc.*, 707 F.3d 1330, 1338 (Fed. Cir. 2013) (expert's *ipse dixit* statements entitled to little weight); *TechSearch, LLC v. Intel*

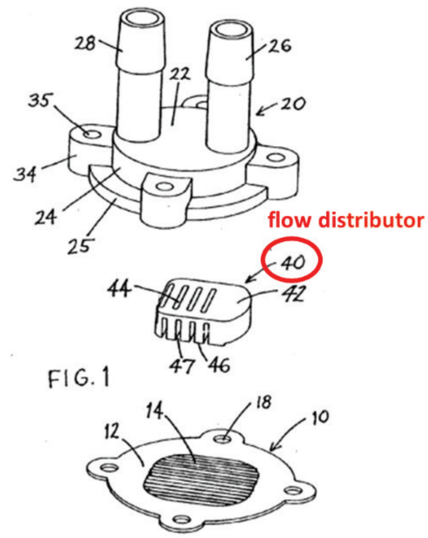
[9] This alternate mapping is further deficient because Petitioner maps Kang's cover 20 to the claimed housing (*see* Pet., 80), whereas Claim 13 requires a seal to be "a portion of the plate."

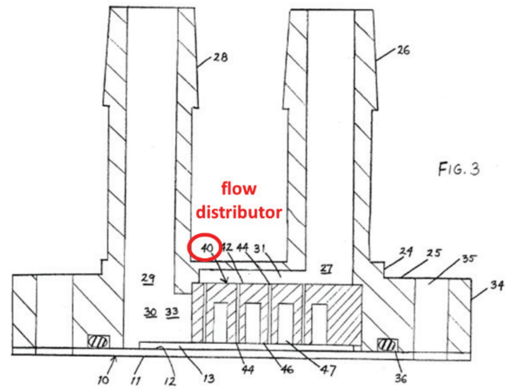
Corp., 286 F.3d 1360, 1372 (Fed. Cir. 2002); *Minkin v. Gibbons, P.C.*, 680 F.3d 1341, 1351-52 (Fed. Cir. 2012).

These naked assertions are laid bare by the fact that Petitioner and Dr. Tilton fail to provide *any* explanation as to why a POSITA would be motivated to modify Kang's particular design to include a "seal, wherein the seal is a portion of the plate." (Pokharna¶94.) Given Petitioner and Dr. Tilton's position that fluid is already prevented from flowing between the inlet section and the outlet section by shoulder **39**, Petitioner and Dr. Tilton do not explain why a POSITA would have had any motivation to alter Kang's working design. (Pokharna¶94.) Accordingly, Petitioner fails to show that Kang discloses a "seal," let alone a "seal [that] is a portion of the plate" under a proper construction of "seal" as "a <u>component</u> that fills a gap to prevent leakage through the gap." (Pokharna¶94.)

2. Kang does not disclose a "plate"

As noted, Petitioner maps flow distributor **40** to the claimed "plate." (Pet., 79.) However, Dr. Tilton testified that "[a] plate is a – generally some kind of <u>flat structure</u>." (Tilton Depo., 11:1-8.) Figures 1 and 3 of Kang make clear that flow distributor **40** is not a "flat structure":





(Kang, FIGS. 1, 3; Pokharna¶95.) Kang never refers to flow distributor **40** as a "plate,"[10] and Dr. Tilton's testimony confirms that a POSITA would not have understood flow distributor **40** to be the claimed "plate." (Pokharna¶95.)

3. Kang does not teach "a fluid outlet passage configured to receive the heat exchange fluid from the first end and the second end of each microchannel, wherein the fluid outlet passage has a first outlet region positioned adjacent the microchannel first ends and a second outlet region positioned adjacent the microchannel second ends"

a. Kang does not disclose "microchannels"

As a threshold matter, Kang does not disclose "microchannels," which Petitioner and Patent Owner stipulated to mean "channels with widths up to 1

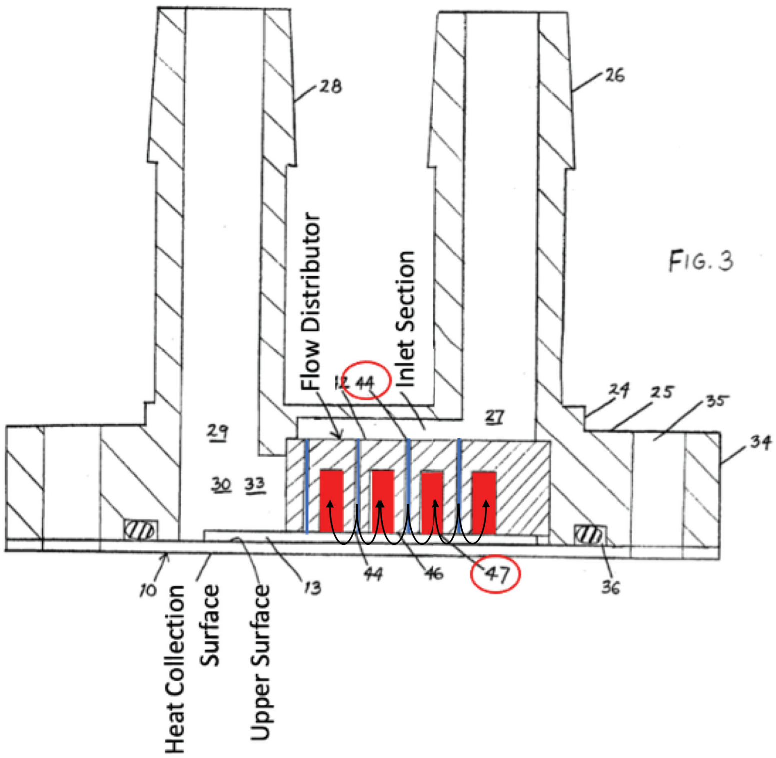
[10] Compare with Kang's use of "plate" to describe "cooling plate 10."

millimeter." (*See* Ex. 1009, 3.) Rather, Kang discloses microfins with grooves between them, but does not specify the width between adjacent microfins. (Kang, [0028]). Petitioner incorrectly alleges that Kang discloses microchannels because Kang fails to teach a channel width.[11]

b. Kang's purported fluid outlet passage does not receive heat exchange fluid from the first end and the second end of each microchannel

Turning now to the flow of coolant through Kang's device, a flow path is depicted in annotated Figure 3:

[11] Petitioner's failure of proof cannot be cured by new or shifting arguments in reply. *See Asetek Danmark, A/S v. CoolIT Systems, Inc.*, IPR2019-00705 (Paper 43), at 20 (P.T.A.B. Aug. 21, 2020); *Intelligent Bio-Sys. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369-70 (Fed. Cir. 2016); *Wasica Fin. GmbH v. Continental Automotive Sys.*, 853 F.3d 1272, 1286-87 (Fed. Cir. 2017).

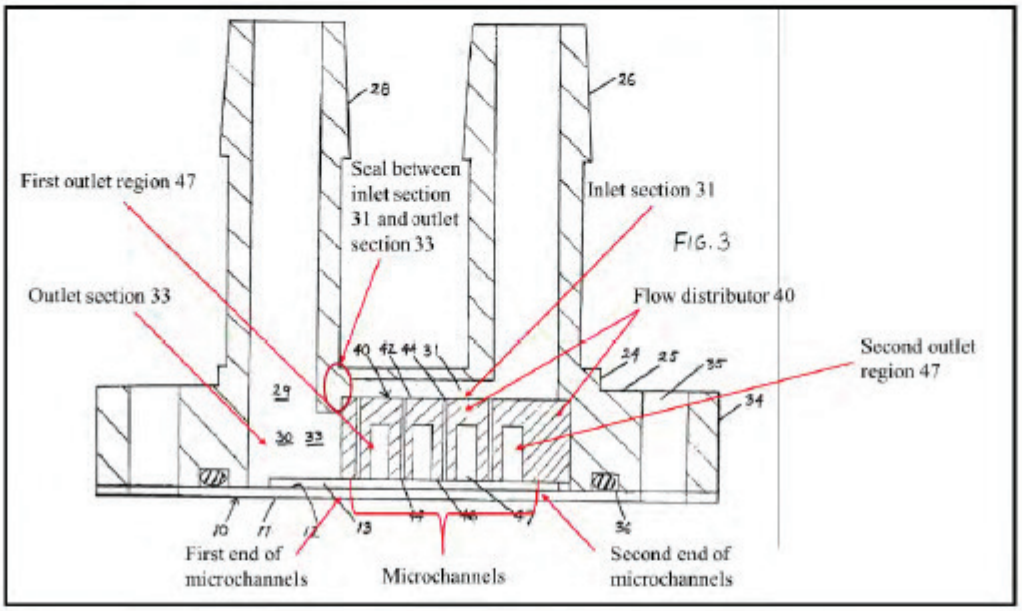


(Kang, FIG. 3 (annotated).) Cooling fluid enters inlet section **31** through inlet port **27** and is distributed among the several inlet channels **44** (in **blue**) defined by Kang's flow distributor **40**. (Kang, [0028]-[0029]; Pokharna¶97.) On exiting from a given inlet channel **44** into gap **48** (not shown in FIG. 3, but understood to be the gap between lands **46** and upper surface **12**), the fluid changes direction and flows along the channel (or purported "microchannel") of fin 13 until it reaches a nearby outlet channel **47** (in **red**). (*Id.*, [0030]; Pokharna¶97; *accord* Tilton Decl., ¶179.)

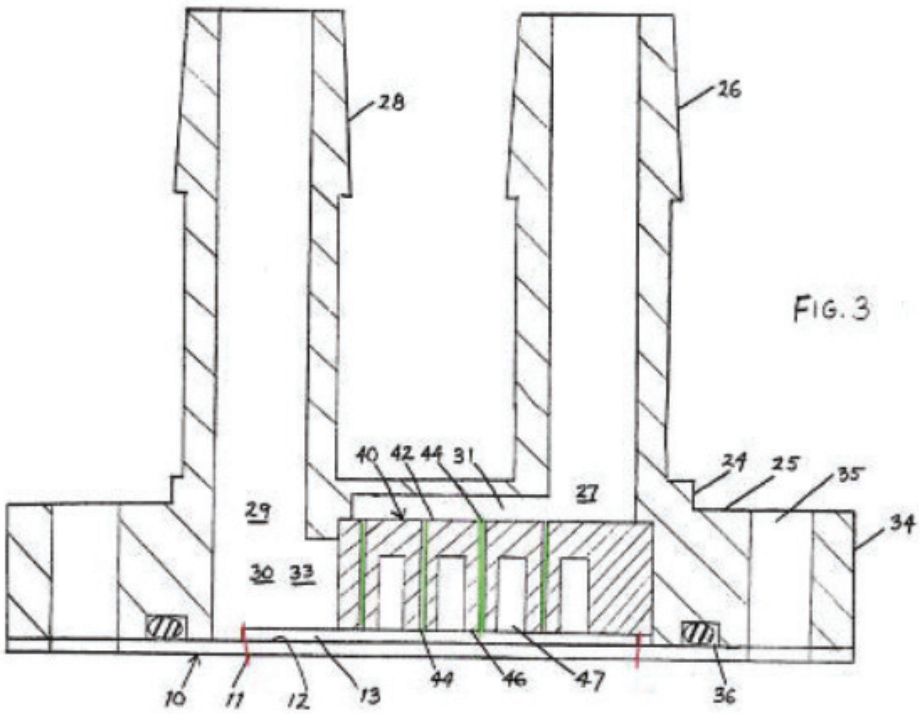
On reaching the outlet channel **47**, fluid within the channel (or purported "microchannel") again changes direction, flowing upward (z-direction, FIG. 1) into

the outlet channel **47**. (Pokharna¶98.) Once in the outlet channel **47**, the fluid changes direction (again) and flows laterally (x-direction, FIG. 1) along the outlet channel **47** until the flow reaches the edge of the flow distributor **40**, where it exits the outlet channel and enters the outlet section **33**. (*Id.*; Pokharna¶98)

Petitioner acknowledges that Kang's device forces coolant to enter the channels (or "microchannels") through inlet channels **44** in the flow distributor **40**. (Pet. 81-83; Tilton Decl., ¶¶177-178; Pokharna¶99.) Petitioner also acknowledges that coolant exits through the nearest outlet channels **47** on either side of inlet channels **44**. (Pet. 82-83; Tilton Decl., ¶179; Pokharna¶99.) But Petitioner and Dr. Tilton also state that "some coolant will instead continue to flow outwards towards the ends of the microchannels and exit through outlet channels 47 at the first and second ends of the microchannels." (Pet. 84; Tilton Decl., ¶179; Pokharna¶99.) Petitioner provided an annotated figure pointing to the first and second outlet regions shown as outlet channels **47**:



(Pet., 83.) However, even if Petitioner and Dr. Tilton were able to demonstrate that fluid will continue to flow outwards towards the ends of the "microchannels," Petitioner and Dr. Tilton have failed to satisfy the limitation of "a fluid outlet passage configured to receive the heat exchange fluid from the first end and the second end of each microchannel, wherein the fluid outlet passage has a first outlet region positioned adjacent the microchannel first ends and a second outlet region positioned adjacent the microchannel second ends." (Pokharna¶100.) Kang's device has no outlet channel **47** positioned at either end of the microchannels, as Petitioner's expert Dr. Tilton confirmed during his deposition. (Kang, FIG. 3; Tilton Depo., 12/17/20, 102:23-103:11; Ex. 2044; Pokharna¶100.) During deposition, Dr. Tilton annotated Kang's FIG. 3 to identify the ends of Kang's microchannels in red, as shown below:



(Ex. 2044.)

Dr. Tilton's annotations to Kang's FIG. 3 above show one end (a first end) of the microchannel is positioned under outlet port **29** and the other end (a second end) of the microchannel is positioned under flow distributor **40**. (Tilton Depo, 12/17/20, 104:3-8; Ex. 2044; Pokharna¶101.)

As can be seen above, any fluid that theoretically reaches the <u>first end</u> of the "microchannels" would, therefore, flow directly into outlet section **33**, rather than to the first outlet region **47** and then to section **33**. (Pokharna¶102.) Moreover, as shown above, the nearest outlet channel **47** to the <u>second end</u> of the microchannel is

positioned inboard (to the left in FIG. 3) of the second end. (*Id.*; Pokharna¶102.) Therefore, any fluid that theoretically reaches the second end of the "microchannels" would flow to the right of the second end in Figure 3, not back through second outlet channel **47**.[12] (Pokharna¶¶102-103.) Accordingly, Petitioner's Ground 5 also fails for not satisfying this limitation.

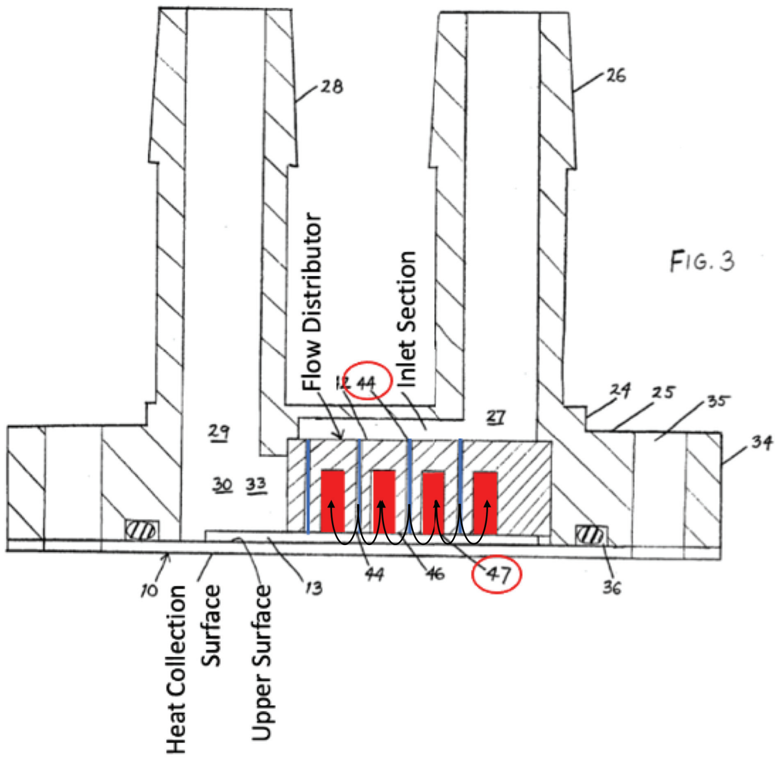
4. Kang does not teach "a fluid inlet passage configured to deliver a heat-exchange fluid through one aperture in the plate to each microchannel" and "wherein a flow of the heat-exchange fluid through the one aperture in the plate bifurcates into two sub flows within each microchannel, wherein the first outlet region receives one of the two sub flows adjacent the microchannel first ends and the second outlet region receives the other of the two sub flows adjacent the microchannel second ends"

Claim 13 recites that "a flow of the heat-exchange fluid through the one aperture in the plate bifurcates into two sub flows within each microchannel" and that "the first outlet region receives one of the two sub flows adjacent the microchannel first ends and the second outlet region receives the other of the two

[12] Fluid that enters the nearest outlet channel **47** to the microchannel second end does not arrive from the second end of Kang's microchannel but rather from a region between the last outlet channel **47** and the microchannel first end under the inlet port **29**. (Pokharna¶102, FN13.)

sub flows adjacent the microchannel second ends." The claim language requires that there be a single aperture in the plate that bifurcates into two sub flows. (Pokharna ¶105.) For brevity, Patent Owner refers to this combination hereafter as the "two sub flows limitation."

According to Petitioner, Kang's flow distributor **40** creates multiple split-flows throughout the length of each channel, which shortens the coolant flow path through the microchannels, and thereby lowers pressure drop and flow resistance through the channels and enhances heat transfer. (Tilton Decl., ¶163, (citing Kang, [0013], [0014]).) Such split flows are illustrated by the arrows shown in the annotated version of Kang's FIG. 3:



(Kang, FIG. 3 (annotated); Pokharna¶106.)

As a consequence of these multiple split-flows, fluid from one inlet channel **44** splits and encounters an opposing flow from another inlet channel **44**, as the arrows indicate above. (Pokharna¶107.) These opposing flows counter each other's lateral (left and right in FIG. 3) momentum, causing the bulk lateral fluid motion to stall and to direct the flow upward into a nearby outlet channel **47**, as the arrows added to FIG. 3 also show. (*Id.*; Kang, [0030].) That is, as the two opposing flows meet, their opposing lateral momentum will cause the flows to mix and to enter a nearby outlet channel **47**, as the arrows indicate. (Pokharna¶107.)

Even though fluid flows mix (and theoretically some water molecules may reach both microchannel ends as explained below), a POSITA would not have understood this to mean that there are two sub flows that reach both ends of the microchannels. (Pokharna¶108.) Rather, a POSITA would have been concerned with bulk fluid motion through Kang's device and would have interpreted the two sub flows limitation as concerning bulk fluid motion. (*Id*.) A POSITA would have considered that the bulk flow of fluid from one inlet channel **44** would not flow past several outlet channels **47** to reach opposite ends of the microchannels, but rather would exit the nearest outlet channel. (*Id.*) Accordingly, a POSITA would not have considered Kang's device to satisfy the two sub flows limitation. (*Id.*)

Acknowledging this deficiency in Kang, Petitioner posits that (1) "some" coolant from any one inlet channel will flow "towards the ends of the microchannels and exit through outlet channels 47 at the first and second ends of the microchannels;" and (2) a POSITA would have been motivated to eliminate all but one inlet channel **44** and all but two outlet channels **47** at the ends of the microchannels to achieve the claimed flow path. (Pet., 84-85; Tilton Decl., ¶¶182-184.)

But Petitioner's mapping of "some" coolant to the two sub flows limitation is based on conclusory and unsupported expert testimony and does not focus on bulk

fluid motion. (Pokharna¶110.) Even if "some" coolant in each sub flow might flow into a further-away outlet channel due to Brownian motion or turbulent mixing, as Petitioner appears to posit, neither Petitioner nor Dr. Tilton explain why a POSITA would have considered that to be an actual "sub flow" that reaches a microchannel end and then is received by an outlet region. (Pokharna¶110.)

A POSITA would not have interpreted the two sub flows limitation in such a manner. First, a POSITA would have understood that any portion of a sub flow that might reach a further-away outlet channel would be negligible in terms of mass flow rate of the original sub flow and it would also provide negligible, if any, of the cooling provided by the original sub flow. (Pokharna¶111.) This is because most of the sub flow will exit the nearest outlet channels **47** on the sub flow's path and any remainder of the sub flow will tend to exit each additional outlet channel before reaching the end of the microchannel. (Pokharna¶111.)

By Dr. Tilton's own acknowledgment, small hydraulic diameters associated with microchannels provide a high flow resistance through the microchannels. (Tilton Decl., ¶158.) As fluids flow along paths of least resistance, the high flow resistance in a microchannel would tend to direct fluid from the microchannel into a nearby outlet channel **47**. (Pokharna¶112.) Kang's device with its many outlet channels provides a short flow path within the microchannels. (*Id.*; Tilton Decl.,

¶163; Kang, [0013]-[0014].) On Petitioner's theory that "some" portion of a sub-flow would reach a further-away outlet channel **47**, "some other, larger portion" of each of the two sub flows also would exhaust from many outlet channels. (Pokharna¶112.) Thus, the flow through the claimed one aperture would actually divide into many sub flows, rather than "bifurcate into two sub flows" as claim 13 recites. (*Id.*)

Second, a POSITA would have appreciated that any portion of a sub flow through a given inlet channel **44** that does not exit a nearby outlet channel **47** would be balanced by a corresponding portion of sub flow from another inlet channel. (Pokharna¶113.) This is because mass conservation requires the mass flow rate of fluid entering the microchannels to equal the mass flow rate of fluid exiting the microchannels. (*Id.*)[13] A POSITA would not have considered flow entering through any one of Kang's multiple inlet channels **44** to "bifurcate[] into two sub flows within each microchannel" and exhaust from both the first end of the microchannels

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[13] Dr. Tilton's annotated versions of Kang's FIG. 3 (Pet. 84, Tilton Decl., ¶183) are misleading because the arrows appear to depict bulk fluid motion when they actually depict paths of fluid dispersion (*e.g.*, as occurs when a drop of food coloring is allowed to fall into a glass of water) or mixing. (Pokharna¶113, FN14.)

and from the second end of the microchannels into the first and second outlet regions. (*Id.*)

Lastly, Petitioner's assertion runs counter to Kang's express statement that flow moves between inlet channels **44** and outlet channels **47** in a general direction toward outlet **29**. (Kang, [0030]; Pokharna¶114.) The Petition provides no reasoned explanation for why a POSITA would have ignored this disclosure in Kang and instead adopt Petitioner's unclear interpretation that "some" coolant reaching both ends of Kang's microchannels satisfies the two sub flows limitation.

5. A POSITA would have been deterred from modifying Kang's device by eliminating all but one inlet channel and all but two outlet channels to provide "a fluid outlet passage configured to receive the heat exchange fluid from the first end and the second end of each microchannel"

As a threshold matter, Petitioner acknowledges Kang's flow distributor **40** creates multiple split-flows throughout the length of each channel, which shortens the coolant flow path through the microchannels, and thereby lowers pressure drop and flow resistance through the channels and enhances heat transfer. (Tilton Decl., ¶163, (citing Kang, [0013]-[0014]).) Compared to larger channels through conventional heat exchangers, small hydraulic diameters associated with microchannels increase flow resistance and thus increase pressure drop as a fluid passes along the length of the microchannels. (Pokharna¶115; *accord* Tilton Decl.,

¶164.) Nonetheless, microchannels also substantially increase surface area available for heat transfer compared to channels through conventional heat exchangers. (*Id.*)

Kang's device, with its multiple inlets and outlets that generate multiple split-flows, balances this tension between increased flow resistance imposed by microchannels and increased heat transfer achieved by microchannels. (Pokharna¶116.) For example, Kang's many inlets and outlets provide a short flow length within the microchannels from the point of entry to the microchannels to the point of exit from the microchannels. (*Id.*; Kang, [0009].) By keeping the flow path short, the pressure drop from each microchannel entrance (inlet channel **44**) to the corresponding microchannel outlet (outlet channel **47**) remains low compared to a longer flow path through the microchannels. (*Id.*) Consequently, the overall pressure drop from Kang's inlet section **31** to Kang's outlet section **33** also remains low compared to a longer flow path through the microchannels, as the various inlets and outlets are fluidly coupled with each other in parallel. (*Id.*)[14] Nonetheless, Kang maintains high overall rates of heat transfer from the heat transfer surface **12** because the inlet channels **44** spread the delivery of cool fluid over the heat transfer surface

[14] This is analogous to electrical circuits that reduce overall circuit resistance by coupling electrical resistors in parallel. (*Id.*)

and the multiple outlet channels **47** promptly remove the heated fluid from the heat transfer surface. (*Id*.)

Given the advantages attained by Kang's use of multiple inlet channels **44** and multiple outlet channels **47** (*e.g.*, low pressure drop and enhanced heat transfer), a POSITA would have had no reason to modify Kang's device by eliminating all but one inlet channel **44** and all but two outlet channels **47** as Petitioner proposes. (Pokharna¶117.) A POSITA would not have effectively blocked all but two of Kang's outlet channels in the flow distributor **40** because doing so would have prevented the fluid from quickly exiting Kang's microchannels provided by the multiple split-flows. (*Id.*) Instead, the blocked outlet channels would keep coolant within Kang's microchannels from exiting earlier. This would significantly decrease the rate of heat transfer from the fins to the coolant, as the difference in temperature between the coolant within the microchannels and the corresponding fins would decrease. (*Id.*) Further, the flow resistance would significantly increase and require more pumping power to drive the coolant through the microchannels of Kang. (*Id.*)

Thus, Petitioner's proposed modifications of Kang would reduce heat transfer and increase flow resistance compared to Kang's device. (Pokharna¶118; Ex. 1012, 5 (describing (1) higher pressure drop for longer flow lengths; (2) larger mass flow rates for longer flow lengths; and (3) a further pressure drop penalty due to larger

mass flow rates).) Petitioner's expert even acknowledges that the proposed modification of Kang would have a detrimental effect on the performance of Kang's device. (Tilton Decl., ¶166.) Accordingly, a POSITA would have been deterred from making the proposed modification as it would reduce the performance of Kang's device. (Kang, Abstract, [0009]-[0016]; Pokharna¶118; Tilton Decl., ¶163.)

Nonetheless, Dr. Tilton posits that "a POSITA in August 2007 would have recognized that [the proposed modification] would still have been reasonable for microchannels of smaller length, and/or if pressure drop could have been minimized using microchannels of larger hydraulic diameters, and/or if pressure drop could be compensated using a higher capacity pump. (Tilton Decl., ¶166; Pokharna¶119.) But mere speculative and conclusory expert testimony "untethered to any supporting evidence" is insufficient to establish that a POSITA would have made the proposed modification. *TQ Delta, LLC v. CISCO Systems, Inc.*, 942 F. 3d 1352, 1362 (Fed. Cir. 2019). In fact, the additional modifications proposed by Dr. Tilton (*e.g.*, larger hydraulic diameters, shorter microchannels) to accommodate the proposed modification to a single inlet and two outlets would further reduce the cooling performance of the modified device. (Pokharna¶119.) For this additional reason, Dr. Tilton's speculative basis for alleging a motivation to modify would further deter a POSITA from making Petitioner's proposed modification.

Because a POSITA would have been deterred from making Petitioner's proposed, performance-reducing modification to Kang's device, the combination of features recited in claim 13 would not have been obvious based on a review of Kang.

6. Petitioner relies on Dr. Tilton's impermissible hindsight reasoning to support its proposed modifications to Kang

The Petition also alleges that a POSITA would have been motivated to eliminate all but one of Kang's inlet channels **44** and all but two of Kang's outlet channels, and to position those outlet channels at the ends of the microchannels "in order to simplify manufacturing complexities and costs." (Pet., 75, 85.) Petitioner relies exclusively on Paragraphs 164-166 in Dr. Tilton's Declaration to support those allegations. (*Id.*)

Dr. Tilton states "[i]f, however, heat transfer performance cannot be met by a single-pass configuration, then performance can be improved by using a split-flow configuration as illustrated by *Lyon*, *Bezama*, *Kang*, and *Anderson*." (Tilton Decl., ¶164 (emphasis in original).) Dr. Tilton explains further that "[t]he choice of how to split the flow using the manifold structure (e.g., to have two flow sections as in *Lyon*, three flow sections as in *Bezama*, or multiple as in *Kang* and *Anderson*) is a simple matter of design choice, not a matter of invention." (*Id.*) Dr. Tilton also states "[i]n fact, the claimed arrangement in the '266 patent is a simplified version of the

Kang system." (*Id.*)

But, neither Lyon 2009 nor Bezama is prior art to Claim 13. Rather, Claim 13 enjoys priority to the 2007 Provisional (which antedates Bezama), as well as to the application that published as Lyon 2009. Petitioner does not dispute this. Dr. Tilton impermissibly relies on the '266 patent and Bezama as a roadmap for piecing together modifications to Kang to arrive at Claim 13.

"The inventor's own path itself never leads to a conclusion of obviousness; that is hindsight." *Otsuka Pharm. Co. v. Sandoz, Inc.*, 678 F.3d 1280, 1296 (Fed. Cir. 2012). Indeed, it is improper to "piece together elements to arrive at the claimed invention" using the patent itself. *In re NTP, Inc.*, 654 F.3d 1279, 1299 (Fed. Cir. 2011); *see InTouch Techs., Inc. v. VGO Comms., Inc.*, 751 F.3d 1327, 1351-52 (Fed. Cir. 2014) (rejecting as hindsight bias expert testimony that relied on the patent at issue as a "roadmap" for putting the "jigsaw puzzle" of prior art elements together); *Grain Processing Corp. v. Am. Maize-Products Co.*, 840 F.2d 902, 907 (Fed. Cir. 1988) ("Care must be taken to avoid hindsight reconstruction by using 'the patent in suit as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in the suit.'").

Petitioner has, therefore, failed to satisfy its burden of providing a

particularized showing that a POSITA would have been motivated to modify the Kang reference. For this additional reason, Petitioner's Ground 5 fails.

7. Petitioner fails to meet its burden to show dependent Claims 14 and 15 are unpatentable

Claims 14 and 15 each depend from, and thus incorporate, the limitations recited in Claim 13. As Petitioner has not met its burden to establish obviousness of Claim 13 in view of Kang, Petitioner has also failed to establish that Claims 14 and 15 would have been obvious over Kang for the same reasons. Additional deficiencies in Ground 5 for the dependent claims are discussed below.

a. Claim 14

Claim 14 recites "wherein the first outlet region is smaller adjacent at least one of the outer microchannels relative to adjacent the centrally located microchannel." Petitioner contends that Kang meets this limitation of Claim 14 due to the relatively longer distance a flow from a central one of Kang's channels must travel through Kang's outlet channel **47** compared to the distance a flow from one of Kang's outer microchannels must travel. (Pet., 86; Decl. Tilton, ¶186.) But this mapping is inconsistent with the express language of the claim and Petitioner's mapping of "outlet region" to Kang's outlet channel **47** in Claim 13. (Pokharna¶125.) Patent Owner addresses these deficiencies below.

A POSITA would have understood that Claim 14 compares the dimensions of the "first outlet region" *in the direction* of the outgoing flows when they first flow out of the microchannels at a position "adjacent at least one of the outer microchannels relative to [a position] adjacent the centrally located microchannel." (Pokharna¶126.) In the case of Kang, it is the "Z" direction in Fig. 1. This is the most natural reading of the limitation that makes sense from a POSITA's point of view because the outlet region at the position "adjacent … one of the outer microchannels" would not overlap with the outlet region at the position "adjacent the centrally located microchannel" when the outlet region's dimensions at the two locations are being compared. (*Id.*)

But Petitioner's mapping of Kang to Claim 14 compares the distance coolant from one microchannel flows within Kang's outlet channel **47** to the distance coolant from another microchannel flows within that outlet channel in the "X" direction that is perpendicular to that of the outflowing flows from the microchannels. (Pet., 87.) Petitioner's mapping has several major problems. First, a large portion of the outlet region mapped by the Petitioner in the "X" direction required to be "adjacent the centrally located microchannel" is not even "adjacent the centrally located microchannel." This is because the purportedly mapped outlet region "adjacent the centrally located microchannel" *extends substantially away from* the "centrally

located microchannel" in the "X" direction. That is, a POSITA would not have considered the Petitioner's mapped outlet region to be "adjacent the centrally located microchannel." Second, the alleged outlet region "adjacent the centrally located microchannel" passes through the same position right above the alleged "one of the outer microchannels" in the "X" direction. That is, the same alleged outlet region "adjacent the centrally located microchannel" is also "adjacent … one of the outer microchannels." That is, the comparison in the limitation at issue is made against the same "outlet region" itself, rendering the comparison meaningless. Indeed, Petitioner has not alleged any difference in dimensional qualities of the outlet channel itself (the alleged outlet region) because there are none. Thus, Petitioner's mapping is inconsistent with the express language of the claim that requires dimensional variation within the claimed outlet region. (Pokharna¶126.)

Petitioner's mapping of Kang to Claim 14 also is inconsistent with its earlier mapping of Kang to Claim 13. (Pokharna ¶127.) Petitioner mapped the entirety of Kang's outlet channel **47** to the "outlet region" recited in Claim 13. (Pet., 83.) There, Petitioner alleged that a first "outlet region" (outlet channel **47**) is positioned adjacent to the microchannel first ends and that a second "outlet region" (outlet channel **47**) is positioned adjacent to the microchannel second ends. (*Id.*) With respect to Claim 14, however, Petitioner attributes a different meaning to "outlet

region." (Pokharna¶¶127-128.)

Rather than maintaining its assertion that an "outlet channel[] … serve[s] as [an] 'outlet region[]'" as it had for Claim 13, Petitioner asserts for Claim 14 that an "outlet region" merely refers to a distance a flow travels through Kang's outlet channel **47**. (Pet., 86; *but cf.* Pet., 83.) In doing so, Petitioner ignores that "a claim term should be construed consistently with its appearance in other places in the same claim or in other claims of the same patent." *Rexnord Corp. v. Laitram Corp.*, 274 F.3d 1336, 1342 (Fed. Cir. 2001).

For these reasons, Petitioner's challenge to Claim 14 in Ground 5 fails.

b. Claim 15

For the same reasons as Claim 14, above, Petitioner's similar challenge to Claim 15 also fails with respect to the limitation: "the outlet opening from the centrally located microchannel is larger than the outlet opening from at least one of the outer microchannels." (Pokharna¶¶129-130.)

D. Ground 6 fails to show how Claims 13-15 are obvious over Anderson

Petitioner relies on Anderson to allege a single-reference obviousness ground challenging Claims 13-15. As noted previously, Anderson is substantially similar to Bhatti, which was considered during examination and overcome in Petitioner's

prior IPR challenge of a related parent application.

Petitioner's reliance on Anderson has several deficiencies. (Pokharna ¶131.) First, Petitioner fails to show with particularity how Anderson discloses all elements of the claims. *Harmonic Inc.*, 815 F.3d at 1363. Second, a POSITA would have been deterred from modifying Anderson's device as alleged by Petitioner because doing so would render Anderson's device unsuitable for its intended purpose of enhancing heat transfer. *In re Fitch*, 972 F.2d at 1265 n.12. Third, Petitioner has not articulated a principled basis for why a POSITA would have been motivated to modify Anderson's device as Petitioner proposes. Instead, Petitioner relies on impermissible hindsight reasoning and conclusory assertions from Dr. Tilton to support its proposed modification. *Metalcraft*, 848 F.3d at 1367. Patent Owner addresses each of these deficiencies below.

1. Anderson does not teach a "seal [that] is a portion of the plate"

Claim 13 recites "a seal, wherein the seal is a portion of the plate." As explained in Section V.D, the term "seal" is properly construed as "a <u>component</u> that fills a gap to prevent leakage through the gap." (Ex. 2029, 42-44.)

Petitioner identifies Anderson's manifold plate **300** as the claimed plate. (Pet., 93-96.) But there is no seal that is a <u>portion</u> of manifold plate **300**. Instead,

Anderson's manifold plate **300** rests within manifold cover **200** with an upper face of the manifold plate contacting interior face **210** of the manifold cover. (Anderson, [0031]; Pokharna¶134.) The lower face of manifold plate **300** overlies upper fin "edges 160 in a crossing pattern." (*Id.*)

Petitioner's mapping first relies on its proposed construction that "seal" merely requires the state of being sealed to argue that Anderson has a seal that is a portion of the plate. (Pet., 94 (first paragraph); Pokharna ¶135.) This argument fails a "seal" must be a structural component.

Petitioner next argues that the plate has "mechanical structures, i.e., 'seals,' <u>on</u> the manifold plate 300." (Pet., 94 (second paragraph)-96 (underlining added).) Specifically, Petitioner relies on Anderson's teaching that "[t]o prevent by-pass leaks created by less than solid contact between coplanar surfaces **330** [of manifold plate **300**] and the coplanar edges **160** [of the fins], a compliant gasket is applied …." (Anderson, [0031].) But Anderson does not, in fact, describe "mechanical structures, i.e., 'seals,' <u>on</u> the manifold plate 300 that can be press-fitted into inner surface 230 of base plate 200," as Petitioner alleges. (Pet., 94 (underlining added) ; Pokharna¶136.) Rather, the disclosure in Anderson makes clear that "a compliant gasket is applied" —not already on manifold plate **300**—and then explains that the process of forming the gasket is by laser machining base plate **100** to form the micro-

fins, not by machining a portion of manifold plate **300**. (Anderson, [0033]-[0035] (laser machining of base plate **100**) ; Pokharna¶136.)

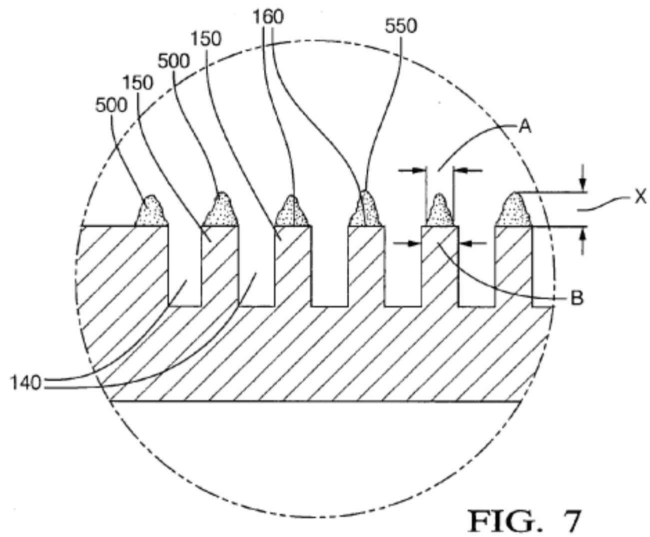

FIG. 7

Additionally, a POSITA would have understood that Anderson's recast layer **500**, which Petitioner alleges is equivalent to a claimed "seal," actually forms as an undesirable by-product of manufacturing Anderson's micro-fins **150**. (Anderson, [0026]-[0033]; Pet., 95-96; Pokharna¶137.) As Anderson explains, recast layer **500** accumulates on top of coplanar edges **160** of fins **150** during a laser micromachining process. (Anderson, [0035]-[0036], FIG. 7; Pokharna¶137.) Anderson further explains that rather than removing recast layer **500** with an acid solution, the recast layer remains <u>on fins **150**</u> because it is malleable enough to serve as a compliant gasket **510** between fins **160** and manifold plate **300**. (*Id.*) Nowhere does Anderson suggest that such a recast layer could be formed as a part of manifold plate **300**, let

alone disclose forming the recast layer on the plate. (Pokharna¶137.)

Petitioner's assertion that "[p]lacing the recast material 500 on the micro-fins 150 or coplanar surface 333 is a matter of engineering design choice" reveals a fundamental misunderstanding of the origins of recast layer **500** and Anderson's purported improvement. (Pokharna¶138.) Anderson discloses the use of laser micromachining a copper plate to form the fin-channel pattern **135**. (Anderson, [0035].) During that process, "the extremely high-energy input ablates the metallic base plate **100** at the point of contact by vaporizing the metallic mass into a plume **530** of aerosol microscopic particulate matter **540**." (*Id.*) That plume of particulate matter condenses and coalesces, which settles by virtue of gravitational force on the coplanar edges **160** of the micro-fins **150**, forming the recast metal layer **500**. (*Id.*; Pokharna¶138.) Rather than washing that recast metal layer away using an acid bath in accordance with previous manufacturing practice, Anderson decided to use the recast by-product as a gasket between the fins and the manifold plate. (*Id.*) Thus, the recast layer arises during formation of the fins and is unrelated to manifold plate **300**. (*Id.*)

Petitioner's annotations to Anderson's FIGS. 2 and 3 (Pet., 94-95) alleging a "seal" exists on manifold plate **300** find no support in Anderson. Apart from conclusory and unsupported expert testimony, Petitioner presents no basis grounded

in the prior art for concluding that a POSITA would have sought to condense and coalesce, or even could have condensed and coalesced, the plume **530** of particulate matter **540** generated from laser micromachining the fins onto Anderson's manifold plate **300**. *See TQ Delta*, 942 F. 3d at 1362 (mere speculative and conclusory expert testimony "untethered to any supporting evidence" is insufficient to establish that a POSITA would have made the proposed modification). Rather, as Dr. Pokharna explains, a POSITA would not have sought to do that. (Pokharna¶139-140.) Laser micromachining as Anderson describes is an expensive manufacturing process typically reserved for devices that require small features, like microchannels. (*Id.*) In contrast to Anderson's microchannels, Anderson's manifold plate **300** and its alternating channels **320** would not require a manufacturing process to have the level of dimensional accuracy required by the microchannels. (*Id.*) Thus, a POSITA would have tended to use a less costly but still adequate manufacturing technique for making manifold plate **300**, and those techniques generally do not give rise to a plume **530** of vaporized metal that could be condensed and coalesced on Anderson's manifold plate. (*Id.*)

For the reasons above, Petitioner has not shown that Anderson renders obvious the seal limitation in Claim 13.

2. Anderson does not disclose "a fluid outlet passage configured to receive the heat exchange fluid from the first end and the second end of each microchannel"

Claim 13 recites "a fluid outlet passage configured to receive the heat exchange fluid from the first end and the second end of each microchannel, wherein the fluid outlet passage has a first outlet region positioned adjacent the microchannel first ends and a second outlet region positioned adjacent the microchannel second ends." Petitioner alleges that Anderson provides outlet channels **320** at the first end and the second end of each microchannel. (Pet., 98.) But Petitioner's annotated version of Anderson's FIG. 5A demonstrates otherwise. (Pokharna¶141; Anderson, [0032] (describing "X" in FIG. 5A as denoting an entrance to the microchannels and "O" in FIG. 5A as denoting an exit from the microchannels.).) Rather, as that annotated drawing shows, inlets ("X") overlie the opposite ends of Anderson's microchannels and exits ("O") are positioned laterally inward of the microchannels ends:

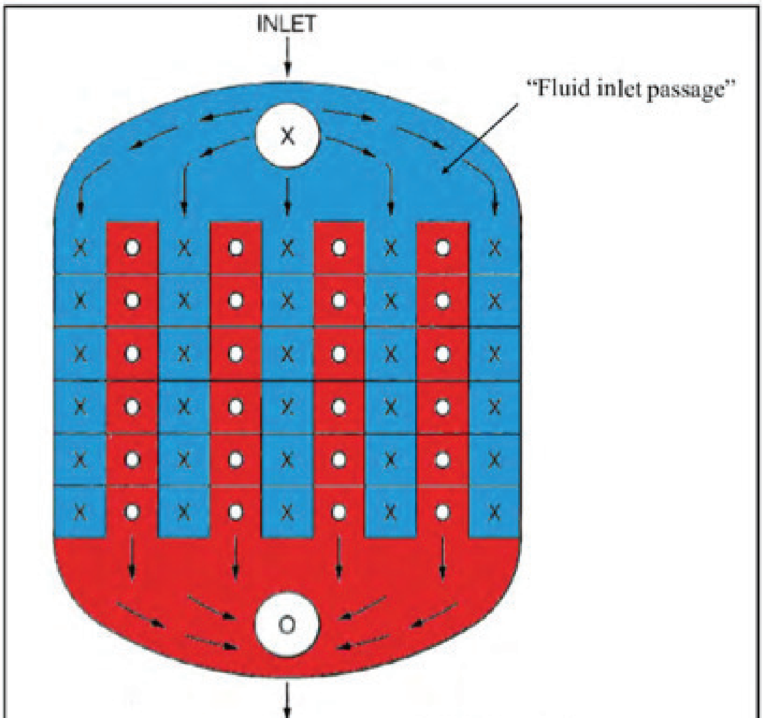

FIG. 5 A

(Pet., 98; Anderson, [0032]; Pokharna¶141.) Thus, Anderson does not disclose an outlet passage configured to receive the heat exchange fluid from the first end and the second end of each microchannel. (*Id.*) Further, Petitioner does not provide any proposed modification to Anderson's device to satisfy this requirement of Claim 13.[15] (Pet., 98-100.)

[15] Petitioner cannot raise new arguments in reply. *See supra*, note 15.

3. Anderson does not teach "a fluid inlet passage configured to deliver a heat-exchange fluid through one aperture in the plate to each microchannel" and "wherein a flow of the heat-exchange fluid through the one aperture in the plate bifurcates into two sub flows within each microchannel, wherein the first outlet region receives one of the two sub flows adjacent the microchannel first ends and the second outlet region receives the other of the two sub flows adjacent the microchannel second ends"

Claim 13 recites that "a flow of the heat-exchange fluid through the one aperture in the plate bifurcates into two sub flows within each microchannel" and that "the first outlet region receives one of the two sub flows adjacent the microchannel first ends and the second outlet region receives the other of the two sub flows adjacent the microchannel second ends." The claim language requires that there be a single aperture in the plate that bifurcates into **two sub flows**. For brevity, this combination is again referred to below as the "two sub flows limitation."

According to Petitioner, Anderson's manifold plate **300** creates multiple split flows within Anderson's microchannels. (Pet. 90-91; Tilton Decl., ¶214; Anderson, FIG. 5B.) As in Kang, Anderson's multiple split flows (FIG. 5B) shortens the flow path through the microchannels, thereby lowering pressure drop and enhancing heat transfer through Anderson's device. (Pokharna¶144.)

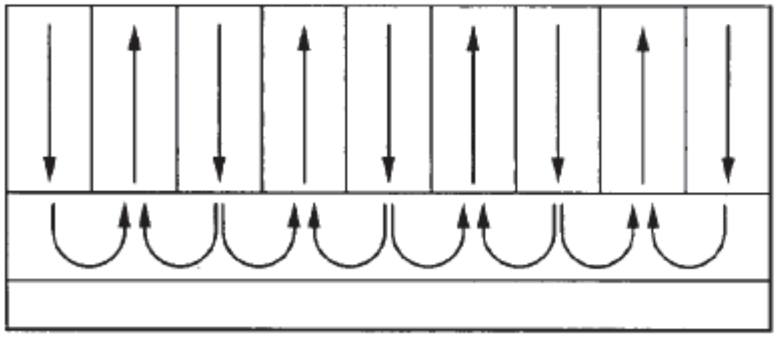

FIG. 5 B

Due to these multiple split-flows, fluid from one inlet channel **320** splits and encounters an opposing flow from another inlet channel **320**, as the arrows indicate above. (Pokharna¶145.) These opposing flows counter each other's lateral (left and right in FIG. 5B) momentum, causing the bulk lateral fluid motion to stall and to direct the flow upward into a nearby outlet channel **320**, as the arrows in FIG. 5B also show. (*Id.*; Anderson, [0032].) As those two opposing flows meet, their opposing lateral momentum will cause the flows to mix and to enter a nearby outlet channel. (Pokharna¶145; Anderson, FIG. 5B.)

Even though fluid flows mix (and theoretically some water molecules may reach both microchannel ends as explained below) a POSITA would not have understood this to mean that there are two sub flows that reach both ends of the microchannels. Rather, a POSITA would have been concerned with bulk fluid

motion through Anderson's device, as FIG. 5B depicts, and would have interpreted the two sub-flows limitation as concerning bulk fluid motion. (Pokharna¶146.) A POSITA would have considered that the bulk flow of cooling fluid from one inlet channel would not flow past several outlet channels to reach both ends of the microchannels, but rather would exit the nearest outlet channel. (*Id.*) Accordingly, a POSITA would not have considered Anderson's device as satisfying the two sub flows limitation. (*Id.*)

Acknowledging Anderson's deficiency, Petitioner posits that (1) "some" coolant from any one inlet channel will flow "towards the ends of the microchannels and exit through outlet channels at the first and second ends of the microchannels" (of which there are none); and (2) a POSITA would have been motivated to eliminate all but one inlet channel **44** and all but two outlet channels **47** at the ends of the microchannels to achieve the claimed flow path. (Pet., 101-102; Tilton Decl., ¶¶214-216; Pokharna¶147.)

But Petitioner's mapping of "some" coolant to the two sub flows limitation is based on conclusory and unsupported expert testimony, and, moreover, does not focus on bulk fluid motion. Even if "some" coolant in each sub flow might flow into a further-away outlet channel due to Brownian motion or turbulent mixing, as Petitioner appears to posit, neither the Petition nor Dr. Tilton explains why a

POSITA would have considered that to be an actual "sub flow" of fluid that reaches a microchannel end and then is received by an outlet region. (Pokharna ¶148.)

Rather a POSITA would not have interpreted the two sub flows limitation in such a manner. First, a POSITA would have understood that any portion of a sub flow that might reach a further-away outlet channel would be negligible in terms of mass flow rate of the original sub flow and it would also provide negligible, if any, of the cooling provided by the original sub flow. (Pokharna¶149.) This is because most of the sub flow will exit the nearest outlet channels through the plate **300** on the sub-flow's path and any remainder of the sub flow will tend to exit each additional outlet channel before reaching the end of the microchannel. (*Id*.)

By Dr. Tilton's admission, small hydraulic diameters associated with microchannels provide a high flow resistance through the microchannels. (Tilton Decl., ¶158.) As fluids flow along paths of least resistance, the high flow resistance in a microchannel would tend to direct fluid from the microchannel into a nearby outlet channel. (Pokharna¶150.) Consequently, Anderson's device with its many outlet channels provides a short flow path within the microchannels. (*Id.*) On Petitioner's theory that "some" portion of a sub-flow would reach a further-away outlet channel, "some other, larger portion" of each of the two sub flows also would exhaust from many outlet channels. (*Id*.) Thus, the flow through the claimed one

aperture would actually divide into many sub flows, rather than "bifurcate into two sub flows" as Claim 13 recites. (*Id.*)

Second, a POSITA would have appreciated that any portion of a sub flow through a given inlet channel that does not exit a nearby outlet channel would be balanced by a corresponding portion of sub flow from another inlet channel. (Pokharna¶151.) This is because mass conservation requires the mass flow rate of fluid entering the microchannels to equal the mass flow rate of fluid exiting the microchannels. (*Id.*)[16] Thus, a POSITA would not have considered flow entering through any one of Anderson's multiple inlet channels to "bifurcate[] into two sub flows within each microchannel" and exhaust from both the first end of the microchannels and from the second end of the microchannels into the first and second outlet regions. (*Id.*)

Finally, Petitioner's assertion runs counter to Anderson's express disclosure that flow enters and exits alternating channels **320**. (Anderson, [0032]; FIG. 5B.) Petitioner provides no reasoned explanation for why a POSITA would have ignored

[16] Dr. Tilton's annotated versions of Anderson's FIG. 5B (Pet. 101, Tilton Decl., ¶215) are misleading for the same reasons discussed in *supra*, note 17. (*See* Pokharna¶¶151-152, FN18.)

this disclosure in Anderson and instead adopt Petitioner's unclear interpretation that "some" coolant reaching both ends of Anderson's microchannels satisfies the two sub flows limitation. (Pokharna¶152.) For these reasons, Petitioner's Ground 6 fails.

4. A POSITA would have been deterred from modifying Anderson's device by eliminating all but one inlet channel and all but two outlet channels to provide "a fluid outlet passage configured to receive the heat exchange fluid from the first end and the second end of each microchannel"

As a threshold matter, Anderson's manifold plate creates multiple split-flows throughout the length of each microchannel, which shortens the coolant flow path through the microchannels, and thereby lowers pressure drop and flow resistance through the channels and enhances heat transfer. (Pokharna¶153.) Compared to larger channels through conventional heat exchangers, small hydraulic diameters associated with microchannels increase flow resistance and thus increase pressure drop as a fluid passes along the length of the microchannels. (*Id.*) Nonetheless, microchannels also substantially increase surface area available for heat transfer compared to channels through conventional heat exchangers. (*Id.*)

Anderson's device, with its multiple inlets and outlets that generate multiple split-flows, balances this tension between increased flow resistance imposed by microchannels and increased heat transfer achieved by microchannels. (*Id.*, ¶154.) For example, Anderson's many inlets and outlets provide a short flow length within

the microchannels from the point of entry to the microchannels to the point of exit from the microchannels. (*Id.*; Anderson, FIG. 5B.) By keeping the flow path short, the pressure drop from each microchannel entrance to the corresponding microchannel outlet remains low compared to a longer flow path through the microchannels. (Pokharna¶154.) Consequently, the overall pressure drop across Anderson's device also remains low compared to a longer flow path through the microchannels, as the various inlets and outlets are fluidly coupled with each other in parallel. (*Id.*)[17] Nonetheless, Anderson maintains high overall rates of heat transfer because the inlet channels spread the delivery of cool fluid over the heat transfer surface and the multiple outlet channels promptly remove the heated fluid from the heat transfer surface. (*Id.*)

Given the advantages attained by Anderson's use of multiple inlet channels and multiple outlet channels (*e.g.*, low pressure drop and enhanced heat transfer), a POSITA would have had no reason to modify Anderson's device by eliminating all but one inlet channel and all but two outlet channels as Petitioner proposes. (Pokharna¶155.) A POSITA would not have effectively blocked all but two of

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[17] This is analogous to electrical circuits that reduce overall circuit resistance by coupling electrical resistors in parallel. (Pokharna¶154, FN19.)

Anderson's outlet channels in the manifold plate 300 because doing so would have prevented the fluid from quickly exiting Anderson's microchannels 150 provided by the multiple split-flows. (*Id.*) Instead, the blocked outlet channels would keep coolant within Anderson's microchannels from exiting earlier. (*Id.*) This would significantly decrease the rate of heat transfer from the fins to the coolant, as the difference in temperature between the coolant within the microchannels and the corresponding fins would decrease. (*Id.*) Further, the flow resistance would significantly increase and require more pumping power to drive the coolant through the microchannels. (*Id.*)

Thus, Petitioner's proposed modifications of Anderson would reduce heat transfer and increase flow resistance compared to Anderson's device. (Pokharna¶156; Ex. 1012, 5 (describing (1) higher pressure drop for longer flow lengths; (2) larger mass flow rates for longer flow lengths; and (3) a further pressure drop penalty due to larger mass flow rates).)

Petitioner's expert is silent regarding these detrimental effects on the performance of Anderson's device. (Tilton Decl., ¶¶214-216.) Instead, Dr. Tilton merely provides the conclusory statement that "a POSITA in August 2007 would have been motivated to modify Anderson's manifold plate 300 to have only a single inlet channel and two outlet channels at the ends of the microchannels 140 (instead

of have a series of alternating inlet and outlet channels) in order to reduce manufacturing costs and complexities." (*Id.*, ¶216.) Again, mere speculative, conclusory, and uncorroborated expert testimony is insufficient to establish whether a POSITA would have made a proposed modification. *TQ Delta*, 942 F. 3d at 1362.

In fact, a POSITA would have understood that the laser machining process for making the microchannels **150** would have been costly. (Pokharna¶158.) A POSITA would not have in turn taken steps to knowingly reduce the cooling effectiveness of those microchannels by saving on the much lower manufacturing costs of Anderson's manifold plate **300**. (Pokharna¶¶158-159.) Rather, a POSITA would have been deterred from making Petitioner's proposed, performance-reducing modification to Anderson's device.

Petitioner thus failed to satisfy its burden of providing a particularized showing that a POSITA would have been motivated to modify the Anderson reference. Claim 13 would not have been obvious over Anderson.

5. Petitioner's impermissible hindsight reasoning fails to establish *prima facie* obviousness from Anderson

The Petition also alleges a POSITA would have been motivated to eliminate all but one of Anderson's inlet channels and all but two of Anderson's outlet channels and to position those outlet channels at the ends of the microchannels "in

order to simplify manufacturing complexities and costs" for reasons "as discussed with regard to Ground 5." (Pet. 101-102.)[18]

As discussed above with respect to Ground 5, Petitioner's arguments for the proposed modifications rest on impermissible hindsight reasoning. Petitioner has, therefore, failed to satisfy its burden of providing a particularized showing that a POSITA would have been motivated to modify the Anderson reference.

6. Petitioner fails to meet its burden to show dependent Claims 14 and 15 are unpatentable

Claims 14 and 15 depend from Claim 13 and thus Petitioner fails to meet its burden to show Claims 14 and 15 are unpatentable for the same reasons that Petitioner fails to meet its burden with regard to claim 13. For the same reasons discussed regarding Claims 14 and 15 with respect to Kang, Anderson does not disclose or otherwise teach the limitation, "the first outlet region is smaller adjacent at least one of the outer microchannels relative to adjacent the centrally located microchannel" in Claim 14, nor the limitation, "the outlet opening from the centrally located microchannel is larger than the outlet opening from at least one of the outer

[18] Petitioner relies exclusively on Paragraphs 194-196, 216 in Dr. Tilton's Declaration to support those allegations.

microchannels," in Claim 15. (Pokharna ¶¶162-169.)

VIII. CONCLUSION

Patent Owner respectfully requests the Board find that Petitioner has not shown by a preponderance of the evidence that the challenged claims are unpatentable.

Respectfully submitted,

Dated: January 12, 2021

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CERTIFICATE OF COMPLIANCE

I hereby certify that the foregoing **CORRECTED PATENT OWNER'S RESPONSE** contains 13,904 words, as measured by the word-processor used to prepare this paper and excluding words in the following sections: Cover Page, Table of Contents, Table of Authorities, List of Exhibits, Certificate of Compliance and Certificate of Service.

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CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. Section 42.6, that a complete copy of each of the following documents

Document	Date Served	Date Filed
PATENT OWNER'S RESPONSE (expunged per Paper 24)	January 12, 2021	January 11, 2021
DECLARATION OF HIMANSHU POKHARNA, Ph.D. [Ex. 2038] (expunged per Paper 24)	January 12, 2021	January 11, 2021
CORRECTED PATENT OWNER'S RESPONSE (authorized by Paper 24)	January 12, 2021	January 19, 2021
CORRECTED DECLARATION OF HIMANSHU POKHARNA, Ph.D. [Ex. 2038] (authorized by Paper 24)	January 12, 2021	January 19, 2021
Exhibits 2039-2062	January 12, 2021	January 12, 2021

was filed with the U.S. Patent and Trademark Office/Patent Trial and Appeal Board on the dates so indicated above, and were served upon Petitioner via e-mail to counsel for Petitioners on the dates so indicated above, as follows:

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